ENGINEERING CONSTRUCTION WEEKLY

OCT 16 1939

ENGINEERING NEWS-RECORD

OCTOBER 12, 1939

... glimpse, shown in the view on the cover, of the future dam of great height. See p. 48.

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CORROSION COSTS YOU MORE THAN WROUGHT IRON

3 Right Answers

TO CORROSION PROBLEMS
IN METAL SMOKESTACKS

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These three stacks at the Stamford, Conn., shops of The New York, New Haven and Hartford Railroad are all wrought iron. Wrought iron makes it possible to utilize the many advantages of the metal stack without paying a penalty in too frequent repair and replacement. Wrought iron not only resists the corrosive elements present in flue gases, but also withstands fatigue from the recurrent stresses caused by stack sway. The fact that stacks built of this material in the 1890's and early 1900's are still in active use today is convincing evidence of wrought iron's capacity for service.

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ENGINEERING NEWS-RECORD

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THIS WEEK

● Few large construction jobs have been as remote from means of transportation for materials and supplies as is Ross Dam in Washington, and few have been located in more difficult terrain on which to set up construction plant. This issue gives an account of how the contractors overcame these obstacles. The present structure is but the start of a dam that ultimately will be 653 ft. high.

● Pressure regulators are a material aid to water department engineers but they also introduce some problems, especially where several related regulators are needed. How Denver handles its regulators is told by D. D. Gross on p. 54.

● Sewage plant operators will find much that is worthy of note in the two-year record of operations at Elizabeth, N. J., p. 57, especially the data on sludge handling.

● Something new in foundation sinking is being tried in the deep clay beds under Chicago, as reported on p. 61. Large clay augers are supplanting caissons with success and economy.

● Bridge engineers will find a mass of factual information in N. R. Sack's article on how exploratory work is carried on for the Missouri State Highway Department.

● American engineers are having a hand in roadbuilding in Liberia, West Africa. How their methods are adapted to local conditions is told by A. N. Carter, on p. 67.

● Surveyors who have struggled with the three-point problem should read the solution on p. 76. Skeptics doubt that it always can be solved so easily.

● ● ●

Ten Notable Buildings of 1939

A Special Section in the Oct. 26 Issue

387 tons of Ryerson New Billet Reinforcing Bars used for Sewerage Treatment Plant at Stevens Point, Wisconsin, by Foster-Morris Co., Milwaukee, Contractors.

Work Progresses "on schedule" with Ryerson Reinforcing

There's no waiting for steel when it is ordered from Ryerson. Thousands of contractors have learned by experience that Ryerson can be depended upon to accurately cut, bend, form, bundle, tag, and deliver bars, spirals, etc., at the time specified. Large stocks, experienced crews, complete cutting and forming equipment, and special dispatching methods assure delivery according to exact specifications . . . and on scheduled time.

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Our special Contractors and Builders Division will be glad to work with you on your next job. Whether your problem is one of intricacy of design, large or small tonnage, special service, or limited time, a Ryerson engineer can probably save you time and money. Get in touch with the plant nearest you.

Joseph T. Ryerson & Son, Inc., Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Boston, Buffalo, Philadelphia, Jersey City.

RYERSON *for* REINFORCING

CONTRACTS AND CAPITAL

ENR CONSTRUCTION VOLUME AND NEW CAPITAL . . . FHA MORTGAGES

(,000 omitted)	September 1938 (5 wk.)	September 1939 (4 wk.)	% Change	Nine Months 1938 (39 wk.)	Nine Months 1939 (39 wk.)	% Change
Total	$289,725	$209,337	−10.0	$1,999,760	$2,265,252	+13.3
Private	53,442	63,077	+47.0	637,315	609,806	−4.0
Public	236,283	146,260	−23.0	1,362,445	1,655,446	+21.0
Federal	36,739	32,894	+12.0	261,960	251,787	−4.0
Total New Productive Capital	$374,009	$29,212	−90.0	$3,112,868	$2,178,952	−30.0
Private Investment	122,624	16,641	−83.0	773,171	594,201	−23.0
Federal (non-federal work)	256,209	12,571	−94.0	1,200,579	456,723	−62.0
Federal (federal work)	−4,824	.....	.....	1,139,118	1,128,028	−1.0
FHA Mortgages Selected for Appraisal	$98,432	$87,390*	−11.0	$752,072	$876,173*	+16.0

* Preliminary.

CONSTRUCTION COSTS . . . WAGE RATES . . . PRICES

	October 1938	October 1939	% Change	Changes September to October 1938 Sept.	1938 Oct.	1938 %	1939 Sept.	1939 Oct.	1939 %
ENR Construction Cost Index, 1913 = 100	234.30	236.86	+1.1	232.70	234.30	+0.7	234.97	236.86	+0.8
ENR Building Cost Index, 1913 = 100	195.48	198.50	+1.5	194.80	195.48	+0.3	196.61	198.50	+1.0
ENR 20-CITIES' AVERAGE									
Common Labor	$0.682	$0.685	+0.4	$0.677	$0.682	+0.7	$0.685	$0.685	0
Skilled Labor (Av. 3 Trades)	1.427	1.444	+1.2	1.426	1.427	+0.1	1.444	1.444	0
Bricklayers	1.514	1.538	+1.6	1.519	1.514	−0.3	1.538	1.538	0
Struct. Ironworkers	1.479	1.499	+1.4	1.473	1.479	+0.4	1.499	1.499	0
Carpenters	1.288	1.296	+0.6	1.288	1.288	0	1.296	1.296	0
Cement, per bbl.	$2.57	$2.60	+1.2	$2.57	$2.57	0	$2.60	$2.60	0
Reinforcing steel, per cwt.	2.50	2.42	−3.2	2.48	2.50	+0.8	2.41	2.42	+0.4
Struct. Steel, base	2.10	2.10	0	2.10	2.10	0	2.10	2.10	0
Sand, per ton	1.24	1.20	−3.2	1.24	1.24	0	1.20	1.20	0
Lumber, 2x4 Fir, per M ft.	32.40	33.72	+4.1	31.49	32.40	+2.9	32.30	33.72	+4.4
Lumber, 2x4 Pine, per M ft.	28.39	30.68	+8.1	28.15	28.39	+0.9	28.62	30.68	+7.2
Brick, common, per M	13.81	14.22	+3.0	13.86	13.81	−0.4	14.22	14.22	0
Ready-mixed concrete, c. y.	7.12	7.10	−0.3	7.12	7.12	0	7.10	7.10	0
Struct. Clay Tile, 3x12x12	74.24	73.53	−1.0	74.24	74.24	0	74.27	73.53	−1.0
Paving Asphalt, cars, ton	14.85	13.77	−7.3	15.44	14.85	−3.8	13.77	13.77	0

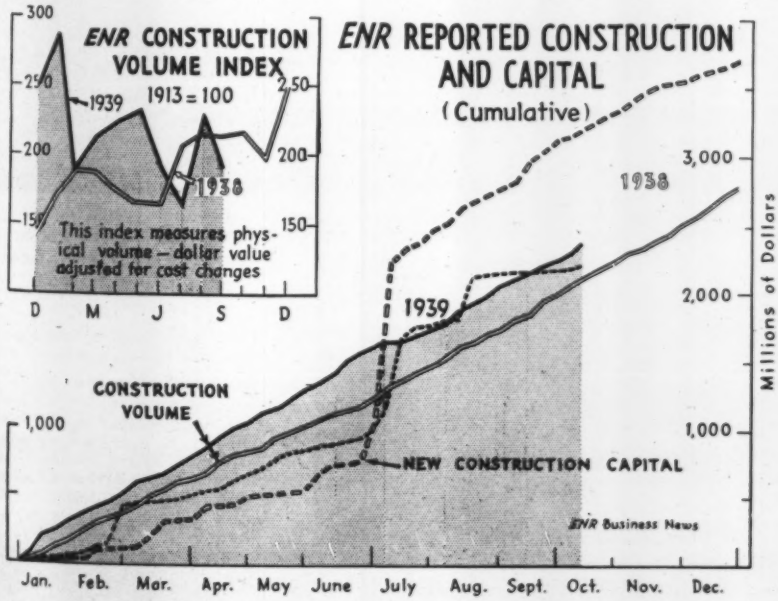
MATERIAL SHIPMENTS . . . BUILDING PERMITS

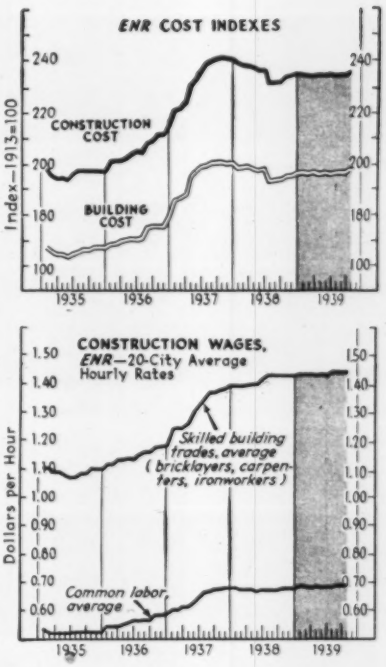
	September 1938	September 1939	% Change	Aug. 1939	% Change Aug.-Sept.
Lumber (% 1929 seas. wk. av.) N.L.M.A.	64.8	73.8	+13.9	71.0	+3.9
Steel (% operating capacity) A.I.S.I.	42.3	73.0	+72.7	61.3	+19.1

	August 1938	August 1939	% Change	Eight Months 1938	Eight Months 1939	% Change
Fabricated Struct. Steel, tons, A.I.S.C.	98,602	137,632	+39.5	753,849	914,158	+21.2
Cement, thous. bbl., U.S.B. of M.	11,823	13,804	+16.8	67,597	79,826	+18.2
Building Permits, Dun & Bradstreet (,000 omitted)	$101,024	$117,832	+16.6	$769,388	$841,973	+9.4

RENT INDEX . . . EMPLOYMENT

	August 1938	August 1939	% Change	July 1939	% Change July-Aug.
Rent (housing) Index, N.I.C.B.	86.6	86.3	−0.3	86.3	0
All Trade Unions, % Employed, A.F.L.	83.0	88.0	+6.0	88.0	0
Building Trades, % Employed, A.F.L.	64.0	75.0	+17.2	76.0	−1.3





CONTRACTS

(Thousands of dollars)

	Week Ending Oct. 13 1938	Oct. 5 1939	Oct. 12 1939
Federal	$9,159	$15,660	$9,151
State & Municipal	25,582	21,085	22,951
Total public	$34,741	$36,745	$32,102
Total private	14,345	17,183	38,541
TOTALS	$49,086	$53,928	$70,643
Cumulative 1939 (41 weeks)			$2,389,823
1938 (41 weeks)			$2,116,800

Note: Minimum size projects included are: Waterworks and waterways projects, $15,000; other public works, $25,000; industrial buildings, $40,000; other buildings, $150,000.

NEW PRODUCTIVE CAPITAL

	Cumulative 1938 41 Wk.	1939 41 Wk.
NON-FEDERAL	$2,080,848	$1,095,448
Corp. securities	334,081	185,260
State & Mun.	468,938	424,781
R.E.A. loans	54,000	89,445
R.F.C. loans	107,128	4,315
P.W.A. allot.	712,394	.....
U.S.H.A. loans	202,807	201,647
Fed. Aid—Hwys.	201,500	190,000
FEDERAL	$1,136,729	$1,128,028
TOTAL CAPITAL	$3,217,577	$2,223,476

FHA MORTGAGES

	Week Ending Oct. 8 1938	Sept. 30 1939	Oct. 7 1939
Selected for appraisal	$22,640	$24,916	$23,095*
Cumulative 1939 (40 weeks)			$899,258*
1938 (41 weeks)			$759,865

* Subject to revision.

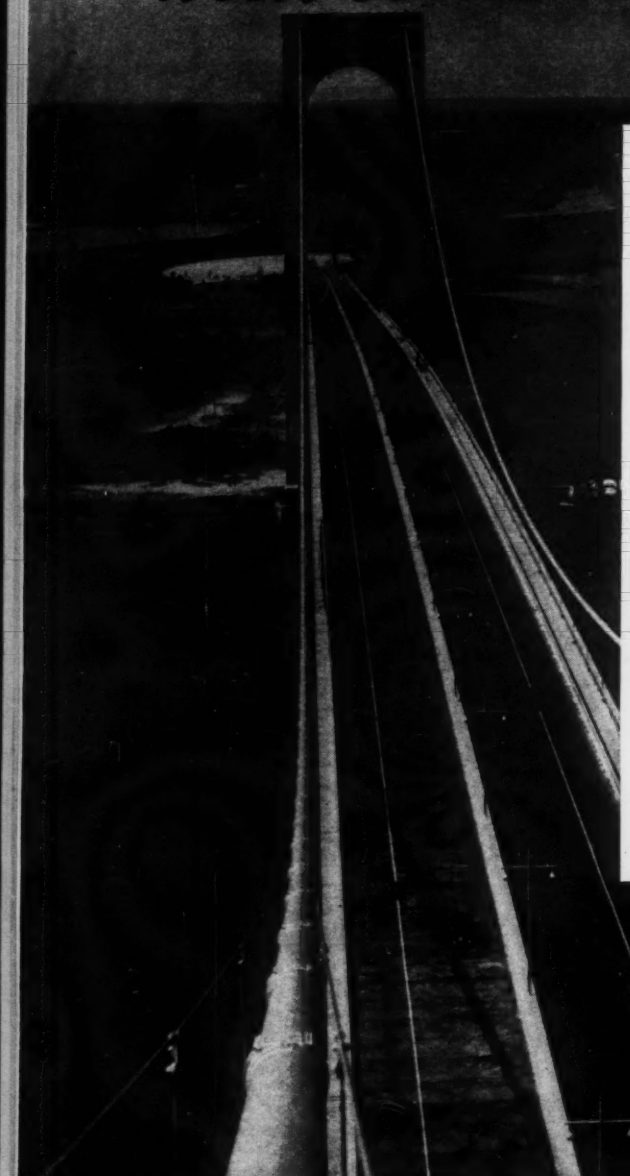
ENR INDEX NUMBERS

Base = 100	Construction Cost 1913	1926	Building Cost '13	'26	Volume '13	'26
Oct., 1939	236.86	113.87	198.50	107.31	...	...
Sept., 1939	234.97	112.95	196.61	106.28	190	83
Aug., 1939	234.90	112.92	196.54	106.24	228	100
Oct., 1938	234.30	112.63	195.48	105.67	217	95
Sept., 1938	232.70	111.86	194.80	105.30	213	93
1938 (Av.)	235.86	113.34	196.83	106.40	197	86
1937 (Av.)	234.71	112.66	196.15	106.07	172	75
1936 (Av.)	206.42	99.15	172.18	93.14	185	81
1935 (Av.)	196.44	94.43	165.76	89.65	134	59

September Construction Table on page 43

ONE MONTH SAVED—COLD WEATHER BEATEN

with Atlas High-Early Cement



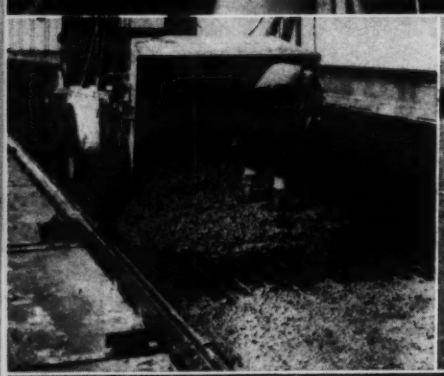
Bronx-Whitestone Bridge completed a month ahead of schedule — in time for opening of N. Y. World's Fair — thanks to Atlas High-Early cement

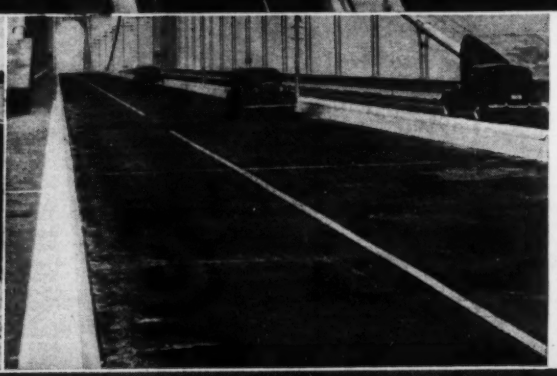
NEW YORK'S Triborough Bridge Authority ordered the Bronx-Whitestone Bridge opened one month ahead of schedule. It was early spring and cold when the decks of the bridge had to be paved. A rapid construction schedule was necessary in weather which was unpredictable more than 36 hours in advance. Further, it was difficult to apply heat effectively to the concrete slab during early hardening and curing. In short, a difficult, tough construction job to be completed on a definite time schedule.

These conditions suggested the use of Atlas High-Early cement. Why? Because with Atlas High-Early strength concrete, less time is required for protection and curing, thereby saving time and costs... because the concrete was safe from freezing within 36 hours under the temperatures which prevailed at the time the bridge was paved... and because the concrete was easily workable with a minimum of water. And so two 27½ ft. roadways 3,850 ft. long were concreted in 12 working days. One-and-a-half-ton batch trucks were hauling loads over the concrete in five days.

Whenever speed in construction is essential, either because of necessity or weather conditions, use Atlas High-Early cement—a cement with rapid-hardening qualities which gains strength several times faster than normal portland cement. Universal Atlas Cement Co. (United States Steel Corporation Subsidiary), Chrysler Bldg., New York.

NR-H





(*Above*)—**YOU'RE LOOKING DOWN** from one of towers of the new Bronx-Whitestone Bridge across the East River, New York City, to the two-lane car roadway paved with Atlas High-Early cement.

• • •

(*Lower left*)—**LOOK AT THE CONCRETE**—see how workable it is. Note how free it is of segregation.

(*Lower right*)—Closeup of road surface.

• • •

O. H. Ammann, chief engineer Triborough Bridge Authority; H. W. Hudson, engineer of construction; Madigan & Hyland, consulting engineers; New York American Bridge Co., General Contractors; Concrete Construction Co., N. Y., sub-contractors on concrete.

Atlas High-Early Cement

ENGINEERING NEWS-RECORD

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Union Paving Bids Low On Pit River Bridge

When bids were opened October 5 at Sacramento, Calif., for the construction of concrete piers and abutments for the Pit River Bridge, part of the Central Valley project and said to be the world's highest double deck bridge, the Union Paving Co., San Francisco, submitted the low bid of $1,138,288. Second low was the Heafey-Moore Co., and Frederickson & Watson Construction Co., Oakland, Calif., with a bid of $1,162,000.

The bridge is to carry the relocated main line of the San Francisco Railroad and four lanes of U. S. Highway 99 traffic across an arm of the future Shasta Reservoir 14 miles north of Redding, Calif. When completed, the lower floor of the structure will be almost 500 ft. above the present level of the river and the tallest pier will be 358 ft. high and 95 x 90 ft. at the base. However, after Shasta Dam is complete, water will rise to within 35 ft. of the lower deck of the bridge.

The Bureau of Reclamation will furnish cement, sand and gravel and reinforcing steel for the substructure work.

• • •

$1,927,000 Road Fund Frozen in Maryland

About $1,927,000 in state funds is tied up in Maryland because the state roads commission failed to use $2,670,000 left over from the federal appropriation since 1936 (*ENR*, Oct. 5, 1939, p. 437). The money was dedicated to either match federal appropriations for major construction or to purchase rights of way for projects which were to be financed only by the federal government. Since the state money was earmarked for a specific purpose, it cannot be put to any other use without jeopardizing the federal appropriation.

Lack of a long range road improvement program is blamed for the accumulation of the unused state and federal funds.

HOGAN NOMINATED FOR A.S.C.E. PRESIDENCY

JOHN P. HOGAN, vice-president and engineering consultant, New York World's Fair, has been nominated for the presidency of the American Society of Civil Engineers. Hogan served as vice-president of the society for two years. He is a member of the firm of Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers, New York.

• • •

$7,000,000 Housing Project Approved for California

A large-scale housing project to cost $7,000,000 has been approved for Baldwin Hills, Calif., the project to be built entirely by private ownership with a FHA loan. The first unit involving an expenditure of $3,500,000, will be started Dec. 1 for housing 633 families.

Known as the "Thousand Gardens," the project gets its name from the basic landscaping plan which will ultimately provide 1,000 gardens. The entire work, including landscaping, service facilities and structures, will be handled by the Joshua Marks-Charde Co. of Los Angeles.

Federal Contracts May Be Modified

Uncertainty due to European war may make changes necessary in government contracts

Possibility of modifying the federal government's standard form of contract for construction and purchases to meet the uncertainty caused by the European war is being studied by the Director of Procurement. Reluctance of contractors to assume long-term obligations because of the possibility of price and wage increases has already become evident in bids received by the Bureau of Reclamation and the Maritime Commission—both in the form of unwillingness to bid on the part of many contractors and the inclusion of large contingency items in bids.

(Continued on p. 40)

• • •

Anti-Trust Law Suits Cost Texas Firms $400,000

Four Texas cement concerns, the Lone Star Cement Corporation, Southwestern Portland Cement Corporation, Trinity Portland Cement Co. and Universal Atlas Cement Co., last week agreed to pay the State of Texas $400,000 and to accept an injunction prohibiting violation of the anti-trust laws. The suit brought against the four companies in the 53rd District Court of Traverse County with the state charging violation of anti-trust laws was dropped, the cement companies to pay all court costs.

• • •

Housing Head Resigns

Alfred Rheinstein, chairman of the New York City Housing Authority, resigned this week after a controversy with Nathan Straus, USHA administrator. Rheinstein, a contractor and engineer, has been repeatedly praised for his efficiency in building the Red Hook and Queensbridge projects.

A. G. C. Discusses Emergency Problems

Fall board meeting in New York devoted to contracting relations as affected by European war

Facing difficult and uncertain times ahead, nearly 200 officers, secretaries and members of the Associated General Contractors of America met in a serious four-day session in New York, Oct. 2-5. The group was chiefly concerned with the effect the European war and the preparedness program in this country will have on construction markets and costs. On Oct. 3 the A.G.C. participated in Construction Day at the New York Worlds Fair.

Activities of the association since its last meeting at St. Paul in June were summed up in a report by E. J. Harding, managing director. He believes the war emergency does not immediately threaten the current steady growth of construction markets, nor do conditions indicate an immediate boom. Growth should continue for the rest of the year, but predictions into next year should be made with caution.

Three emergency problems

Harding sees three big problems facing general contractors because of the emergency: (1) Threat of WPA to take over all "preparedness" construction; (2) mobilization of the construction industry; and (3) construction costs and risks. In referring to WPA, Harding stated "Never in history has a day labor agency voluntarily retired, rather it has grasped every opportunity to extend and entrench itself. Already WPA has announced that it will give first consideration to projects useful in a preparedness program, such as roads, bridges, airports and armories. The issue now is, should preparedness construction and construction in event of war be performed by the inefficient methods of WPA or should they be performed by efficient private construction?" He pointed out that in the face of employment gains WPA activities should be diminishing "unless, of course, it seeks to grasp the emergency as a means of seizing public construction markets and establishing a permanent unemployment roll of displaced construction labor."

As to possible mobilization of all industry, Harding declares the A.G.C. is the most logical civilian organization through which to coordinate the construction industry with the government. The association has recommended that the government, in case of a national emergency, establish a separate board composed of persons fully familiar with construction to handle all construction problems. John W. Cowper, of Buffalo, added that in case of mobilization of industry that labor also should be mobilized.

The problems of contracting risks, protection against rising costs on long-term contracts and cancellation of contracts at the end of the emergency were of chief concern throughout the meeting. In his report, Harding pointed out that under present emergency conditions contractors can no longer assume unqualified responsibility without the addition of increased contingency items, which, obviously, increase the price. During the course of long-term contracts, he stated, operations may be suspended, material prices and wages may increase, and the labor supply may be depleted. The association has already sent suggestions to heads of various federal departments regarding revision of the standard government contract to include protection to the contractor against these risks, and is moving to revive the Joint Conference on Standard Construction Contracts to consider these and other matters pertaining to contract procedure.

This matter of protection against increased costs on long contracts came up repeatedly during the session. All in attendance were in favor of some type of protection, but many hesitated on just how far to go. President Guy F. Atkinson probably summed up the attitude of most of those present with the statement "Of course, contractors want protection, but we must be on guard not to press too far or governmental agencies will favor day labor operations. After all, contractors are gamblers, and we must take some chances." No definite action was taken by the members in session.

Labor relations

E. P. Palmer, of New York, head of the association's labor committee, reported success in following the directions given at the San Francisco convention last March for the labor committee to cooperate directly with organized labor leaders in settling four troublesome points: jurisdictional disputes, uniform working hours for all crafts on one project, maintenance of wage scales for the duration of the job, and training of apprentices. The first point has already been gained, he reported, by the joint action of the A.G.C. and the Building Trades Department of the A. F. of L. last August in settling up means of ending jurisdictional disputes. Immediately following the announcement of the proposal, more than 300 existing disputes came to an end. He also reported that the jurisdictional dispute plan has been officially accepted by the Building Trades Department in recent session at Cincinnati, which required changing the department constitution, and that the other three points had been taken under consideration by labor.

Reporting for the joint A.G.C.-A.A.S.H.O. cooperative committee on highways, Harry J. Kirk said that progress is being made to establish uniform prequalification standards throughout the nation.

The 1940 annual convention of the association will be held at the Peabody Hotel in Memphis, Tenn., Feb. 5-7.

NOMINATED TO HEAD GENERAL CONTRACTORS NEXT YEAR

TWO HIGHWAY CONTRACTORS from the Middle West were nominated to head the Associated General Contractors of America next year at the fall board meeting held in New York last week. H. B. Zachry (left) of Laredo and San Antonio, Tex., and present vice-president of the organization, has been selected for president for 1940. M. W. Watson, of Topeka, Kan., chairman of the highway division of the association, was nominated for vice-president.

Colorado Dam Construction Halted by Silt Deposit

Construction of the earth fill dam of the Yampa Valley Irrigation District project in Colorado was stopped by state and PWA engineers recently when rock stripping operations revealed a deposit of silt in the central part of the dam base having a depth of 34 ft. The contractor, Platt Rogers, Inc., Pueblo, Colo., had been on the project for two months and approximately $80,000 had been spent. Preliminary investigations and drill test cores had failed to show the silt condition, and the contractor has moved his machinery and equipment from the site.

The total project is being financed by a $200,000 federal grant and an additional grant of $80,000 is being sought. The dam was designed to be 860 ft. long and 75 ft. high.

It has been reported that a new site for construction will be sought.

• • •

Omaha Company Buys Power from Loup River

A contract for the sale of power from the hydro-electric plants of the Loup River Public Power District in eastern Nebraska to the Nebraska Power Co. at Omaha was signed in that city on Oct. 2. The Loup River district is one of three public power districts that have built or are building hydro-electric power systems in Nebraska (*ENR* Apr. 27, 1939, p. 546 and May 25, p. 723). The contract covers the output of 5,000 kw of capacity the first year and increases to 25,000 kw. The rate ranges up to a maximum of 5¾ mills per kwh. Because the three power districts have an interconnection agreement this power may be supplied from any one of the plants in the district.

The contract will net the district from $240,000 to $360,000.

Pach Brothers

WINS HOOVER MEDAL

GANO DUNN, president of J. G. White, Engineering Corp., New York, and of Cooper Union, New York, has been awarded the 1939 Hoover medal for "distinguished public service" by the national engineering societies. The medal "signalizes great unselfish, non-technical service by engineers to their fellowmen." Dunn was active in securing the $5,000,000 building and endowment fund for the National Academy of Science and the National Research Council.

CHICAGO SUBWAY SECTION READY FOR A LONG RIDE

THE STEEL twin-tube structure, 200 ft. long and 40x23 ft. in section, which is to form the Chicago River tunnel of the new State St. subway in Chicago, on Sept. 26 was towed out of a South Chicago drydock in which it was built and was moored in a slip while additional concrete is placed around the shell. This view shows the section afloat in the drydock. The tube will soon be towed 15 miles up the lake and into the river to its final resting place, where it will be sunk in a prepared trench and ultimately connected to the land tunnels through transition sections to be built in cofferdams. The steel tube was built by the Graver Tank & Mfg. Co. for the general contractor, Merritt-Chapman & Scott Corp. Ernest Seeman is in charge of the job for the contractor.

Court Orders Denison Dam Report

Secretary Woodring to show why injunction should not be issued to halt Oklahoma work

The U. S. Supreme Court this week ordered Secretary of War Woodring to show cause why an injunction should not be issued against construction of the Denison flood control and hydro-electric dam on the Red River in Oklahoma. The suit was brought by the attorney-general of Oklahoma on instruction of Governor Phillips.

Construction of the dam has been opposed by the Governor ever since his inauguration last January (*ENR*, Sept. 7, 1939, p. 305); he has protested in writing to the Secretary and to President Roosevelt. Some changes were made in the design in an effort to meet his objections, but the project has been pushed forward.

The complaint brought by the state points out that the state supreme court has held that the Red River is not navigable within the state of Oklahoma and asserts that construction of the dam exceeds the constitutional powers of the federal government and also that flood control is not a public purpose.

The waters of the Red River, it is claimed, belong to the state, and the federal government is acting illegally when it attempts to take these waters for generation of power without compensation. The reservoir moreover will wipe out the legally established boundary of the state, and the state will receive no compensation for the social dislocation involved in displacing the present inhabitants of the reservoir area, it is asserted.

This action will be the first court test of the constitutionality of the flood control act of 1938. The act, under which the federal government assumed the full responsibility for flood control, has been the subject of controversy in the New England states.

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Identical Cement Bids Questioned in Wisconsin

Having received 15 identical bids for 300 bbl. of cement, officials of Milwaukee County, Wis., have asked for permission to start suit against as many Milwaukee cement concerns under the state anti-trust act.

The maximum penalty under the criminal section of the law is five years in prison or a $5,000 fine, and under the civil section each firm convicted may be fined from $100 to $5,000 for each offense.

J. Vipond Davies Dies; Tunnel Engineer

J. Vipond Davies, consulting engineer who designed and built the Hudson & Manhattan tubes, first tunnels to be driven under the Hudson River at New York, died Oct. 4 in New York City at the age of 76. Born in South Wales, Davies came to the United States at the age of 27 to join the Philadelphia & Reading Ry. Later he became chief assistant engineer for the New York-New England RR. and the Long Island RR. In 1892–94 he was in charge of driving the famous Ravenswood gas tunnel under the East River at New York, first subaqueous tunnel to be completed in the New York area.

In 1894 he formed the engineering firm of Jacobs and Davies with Chas. M. Jacobs. From the early tunnel days to the time of his death he was vice-president and chief engineer of the Hudson & Manhattan RR. Other activities of his busy engineering life included that of consulting engineer to the Brooklyn Rapid Transit Co. in the extension of elevated, surface and subway lines; construction engineer on 18 miles of aqueduct tunnels in Mexico; in charge of construction of Hales Bar Dam at Chattanooga, Tenn.; consulting engineer on the Moffat Tunnel in Colorado; consultant on a tunnel under the Volga River for the Moscow-Kazan RR.; and a member of the consulting board of the Public Belt RR. in New Orleans studying both bridge and tunnel proposals for crossing the Mississippi River.

At one time he was a member of the New York State Bridge and Tunnel Commission and the New Jersey Bridge and Tunnel Commission. In 1921 he was one of two engineers reporting on bridge and tunnel crossings of San Francisco Bay. In 1914 he was awarded the Norman Gold Medal prize by the American Society of Civil Engineers and also the Telford Gold Medal prize by the Canadian Institute of Civil Engineers. The American society awarded him the Rowland prize in 1918 and again in 1930, a prize for notable papers on construction.

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Canadian Contractors May Be Licensed

A bill under consideration in British Columbia would require all building contractors, not only general but those representing various trades, to have a license. A board of seven members, consisting of four elected by the contractors, two by the government and one by organized labor unions, would consider all applications.

Southern Utility Plans $4,000,000 Expansion

Commonwealth & Southern Corp. last week announced plans for construction of a $4,000,000 generating plant at Macon, Ga. This plant and one at Mobile, Ala., are the first to be started by the company since TVA entered the power field.

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Federal Contracts

(Continued from p. 37)

The procurement director, who is responsible for the standard forms, is, therefore, trying to determine whether a clause ought to be introduced relieving the contractor of the risk of marked fluctuations.

One form of protective clause being considered would provide for modification of a base bid in accordance with the fluctuations of some appropriate index, such as that issued by the Department of Labor. Legality of this procedure is open to doubt and would unquestionably require a finding by the Comptroller-General. Government lawyers in a position to know are of the opinion that the chief legal obstacle is the 1874 act which forbids administrative agencies to exceed their appropriations. An agency letting a contract for an indefinite amount, of course, risks incurring a deficit. They believe, however, that maintenance of a reasonable margin between the amount of the base contract and the available funds would be held by the Comptroller-General to satisfy the law.

NEW BRIDGE FOR GRAND RIVER DAM AUTHORITY

TWENTY-FIVE MILES upstream from the Pensacola Dam in Oklahoma a new $370,000 highway bridge has been built across the reservoir site. The bridge, 2500 ft. in length with concrete piers from 90 to 100 ft. high, provides a 24 ft. roadway between two 4-ft. walkways. Included are 15 120-ft. deck truss spans and 12 60-ft. I-beam spans. The structure was designed by V. H. Cochrane of Tulsa, Okla. and Floyd Oakley was resident engineer for Holway & Neuffer, engineers for the Grand River Dam Authority.

Road Practices Studied In Connecticut

William J. Cox, commissioner of the Connecticut State Highway Department, has inaugurated a fact-finding survey of the practices and policies of his department to determine whether those practices shall continue or be changed. The Public Roads Administration will cooperate in the study.

Mechanics of the survey is to set up within the department an organization to assemble factual data and to weigh Connecticut practices against those of the Administration and the procedures in other states. The survey will also determine methods to help in long range planning for the development of the state highway system.

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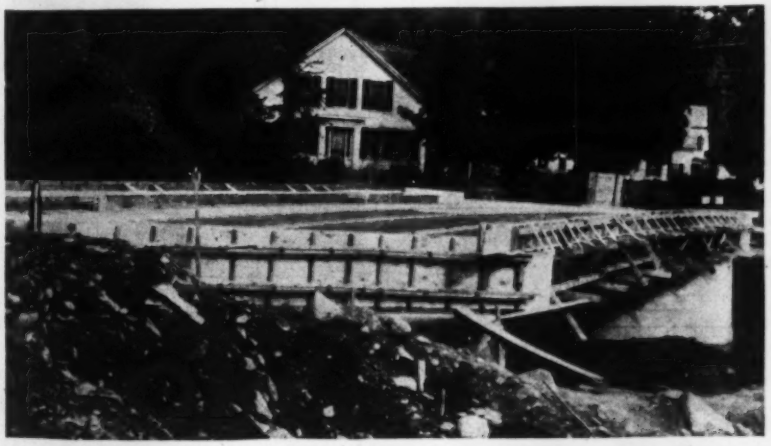
New York State Enters Parkway Toll Fight

The State of New York entered the controversy over the tolls on the Hutchinson River Parkway in Westchester County last week when the state solicitor general appeared before the appellate division of the state courts in Brooklyn and requested that a permanent injunction be issued to prevent a toll collection on the parkway. He asserted that the levying of a toll on a link in the state highway system transcended the local interests of Westchester County.

On August 20 when the collection of a ten-cent toll per vehicle began on the parkway (*ENR*, August 24, p. 244), the action was attacked in the state supreme court by members of the Automobile Club of New York but the members were denied an injunction to restrain the county temporarily from collecting the toll. It is this decision which has been appealed to the appellate division.

PUBLIC WORKS PRESIDENT

JOHN S. FLOCKHART was elected president of the American Public Works Association on Oct. 10, at the society's annual meeting at Pittsburgh, Pa. Flockhart is principal assistant engineer of the Bureau of Street Cleaning, Newark, N. J.



VERMONT STILL REPAIRING BRIDGES YEAR AFTER HURRICANE

THE FIRST ANNIVERSARY of the destructive hurricane and accompanying floods that struck New England in September, 1938, found Vermont state and town highway departments still working to repair the damage to roads and bridges. The above view is a new bridge under construction in the village of Grafton, Vt., to replace an old steel structure swept away by the floods. Other New England states are also still at work on storm damage repairs. The Travelers Insurance Co. reports that property damage on account of the storm amounted to $400,000,000, thus making it "America's costliest disaster" exceeding the San Francisco earthquake by $50,000,000.

Treatment Plant Favored in Toronto

Engineering consultant board reports, advancing two different plans

The board of consultants hired by the City of Toronto to study the city's sewage disposal problem has completed its work and advanced two possible solutions for the city's needs.

A majority finding, signed by four of the five members of the board, recommends a plant for complete treatment, including sludge disposal by digestion, mechanical dewatering and incineration. The estimated cost of this scheme is $9,500,000, compared with $12,000,000 as the original estimate of such an improvement. The difference in price is accounted for by economies in the sludge disposal arrangement, reductions in the size of aeration and final sedimentation tanks, and omission of a seawall protecting the site on Ashbridge's Bay, the suitability of which has been confirmed.

The minority report advanced by W. B. Redfern, Toronto consulting engineer, recommends a filtration system only, which was estimated to cost $5,474,000. Redfern argues that, under the present circumstances, although a filtration system would not give complete treatment, it would be sufficient for the present and would effect an annual saving in operating expenses of $300,000 as compared with the proposal of the majority report. The mayor of the city stated that both proposals will be considered and that action by the authority to start work on some form of treatment will be started in the near future.

Members of the consultant board besides Redfern are: S. A. Greeley of Chicago; C. W. Hubbell, president of Hubbell, Ross & Clark, Inc., consulting engineers, Detroit; G. H. Ferguson, chief engineer of the public health engineering division, department of pensions and national health, Ottawa, and A. E. Derry, director of sanitary engineering, department of public health, Toronto (*ENR*, Aug. 31, 1939, p. 251).

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Illinois Highway Heads Considered as Officers

The attorney-general of Illinois, Sept. 25, ruled that county highway superintendents are officers rather than employees and therefore are ineligible for workmen's compensation benefits.

The opinion had been requested by William R. Roberts, attorney for Sangamon County.

OBITUARY

FRANCIS C. SHENEHON, consulting engineer and hydraulic expert, died on Oct. 3 in Minneapolis at the age of 77. Following graduation from the University of Minnesota, Shenehon worked on railway location with the Minneapolis, Sault Ste. Marie & Atlantic Ry. He advanced from rodman to chainman and then to topographer and finally was resident engineer in charge of construction. At one time he was a member of the firm of Cox & Shenehon, Sault Ste. Marie, Mich. In February, 1889, he went into private practice to work on surveys, design and construction of bridges, topographical surveys for damage suits, and other general engineering work. Ten years later he became dean of the college of engineering at the University of Minnesota, retiring in 1917 to devote his entire time to private practice in consulting hydraulic work. In 1919 he became associated with Adolph F. Meyer under the firm name of Shenehon & Meyer with offices in Minneapolis, specializing in hydraulic work. He acted as an engineering expert for the United States on the Chicago Sanitary District litigation. In 1923 Shenehon became engineering vice-president of the Byllesby Corp. in Chicago.

JOHN R. LAPHAM, professor of civil engineering and dean of the school of engineering at George Washington University, Washington, D. C., died last week at the age of 53. Lapham graduated from Brown University with a degree in civil engineering in 1909 and afterward taught at Pennsylvania State College. He had also worked in the construction department of the New York, New Haven & Hartford R. R. and with the Department of University Extension, Massachusetts State Board of Education.

DAVID A. MOLITOR, civil engineer, formerly of Detroit, died recently in Harlingen, Tex. Molitor began his professional work in 1885 in the employ of the Mobile & Ohio R. R. and later attended Washington University. Starting in 1887, he spent three years on the construction of the Weizen-Immendingen Ry. near Baden, Germany, being engaged in the design of various structures, locating portions of the line and having charge of about five miles of construction. Returning to the United States, he worked on the construction of the Mississippi River bridge at Memphis, Tenn. In 1892 Molitor entered the United States government service as assistant engineer on design work for the new lock at Sault Ste. Marie. He also worked as assistant engineer with the U. S. Army Engineers in the Detroit office.

STEPHEN DEM. GAGE, 62, sanitary engineer, died last week at Providence, R. I. Gage for a time was principal assistant of the Lawrence (Mass.) Experiment Station and later became head of the station, being with that organization eight years. He worked for a time making studies of the effects of metropolitan sewage along the shores and beaches at Boston, as well as studying the effect of sewage on shellfish in Boston Harbor. He also acted as consulting engineer to the city of Youngstown, Ohio, and made studies for Puget Sound, Wash., to determine the effect of mill wastes on shell fish. He was sanitary engineer for the Rhode Island State Board of Health for 16 years.

NATHAN D. WHITMAN, chief engineer of the American Concrete & Steel Pipe Co., Los Angeles, died Sept. 9 at Pasadena, Calif., at the age of 61. He was a graduate of M.I.T. and had been affiliated with the American Concrete Co. for 25 years. Before joining the company for which he last worked, he was engineer in charge of construction of a sewage disposal plant and pumping station and intercepting sewers in Jackson, Mich.

E. H. CRAMNER, JR., 36, waterworks superintendent at Shreveport, La., was shot to death Sept. 3 by a waterworks employee who became mentally unbalanced when advised that he would need to take a physical examination to keep his position.

JACOB HESSER, 70, Toledo contractor and former building commissioner of that city, died there Sept. 29. Hesser drafted the building laws in effect at Toledo at the present time and was commissioner for 18 years, resigning in 1929 to go into the contracting business.

FREDERICK G. JOHNSON, contractor of Ottawa, Ont., died Oct. 3 at the age of 85.

HERMAN MULOCK, 71, general contractor, died Oct. 6 in Atlantic City, N. J. Recently he had been superintendent of a WPA project in Atlantic City.

WILLIAM J. YENNIE, 59, New York City building contractor for the last 30 years, died at Mount Vernon, N. Y., Oct. 5. At one time Yennie was deputy commissioner of public safety for Mount Vernon.

H. W. SHAULL, senior member of the road contracting firm of H. W. Shaull & Son, Mechanicsburg, Pa., died in Mechanicsburg Oct. 1. He was 75 years old.

WILLIAM J. FICKES, 45, head of the highway department of the city of Harrisburg, Pa., died Oct. 3. He had been head of the city highway division since 1934.

HENRY B. PATTEN, 84, retired engineer in the General Land Office, Interior Department, died last week at Washington, D. C. Patten graduated from Rensselaer Polytechnic Institute in 1878, later doing engineering work for the Union Pacific R. R. in Wyoming. Soon he became city engineer at Cheyenne. In 1914 he went to Washington to work for the Interior Department until his retirement 15 years ago.

Other contractors and engineers who have died recently include: T. R. RUTLEDGE, 34, assistant to the chief engineer of the Union Pacific R. R. at Omaha; FRANK B. LONG, builder, of Chicago; ERNEST C. WOODCOCK, 79,

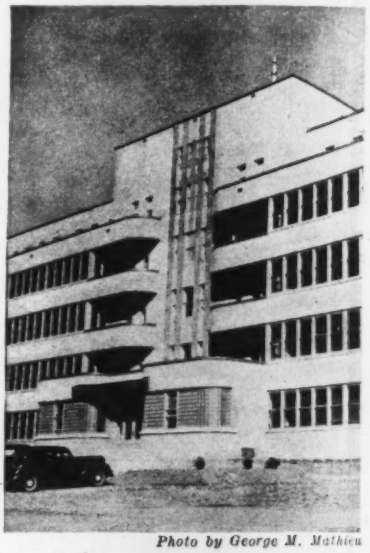


Photo by George M. Mathieu

NEW CANADIAN SANITARIUM

SITUATED MORE THAN 250 miles northeast of the city of Quebec on a high promontory overlooking the St. Lawrence River near the town of Mont Joli, the new St. George sanitarium was officially dedicated last month. Five stories high, built of reinforced concrete with a brick facing for outside walls, the hospital has accommodations for 300 beds and costs about $500,000.

The Komo Construction, Ltd., Quebec City, Quebec, was the general contractor. Lorenzo Auger, Lucien Mainguy & Maurice Mainguy, Quebec City, were the architects.

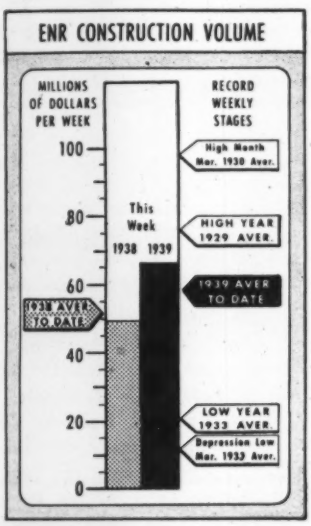
building contractor of Ogden, Utah; JOHN O. MARTIN, 77, building contractor and member of the firm of Martin & Martin, in Denver, Colo.; SOLOMON CAMERON, 78, builder and contractor of Vancouver, B. C., and DENNIS C. NOONAN, contractor and a former general superintendent of the Minneapolis & St. Louis R. R., at Watertown, South Dakota.

CONTRACTS AND CAPITAL

ENGINEERING construction awards for the week, $70,643,000, are 31 per cent higher than last week and 44 per cent above the corresponding week last year. Private awards make up 54½ per cent of the total, the first time since April 14, 1938, that they have exceeded public awards for the same week.

The construction total for 1939, $2,389,823,000, is 13 per cent higher than the $2,116,800,000 reported for the initial 41-week period last year.

Private awards for the week are the highest since April 14, 1938, and are 124 and 168 per cent higher, respectively, than a week ago and a year ago. Public construction is 13 per cent under last week and 8 per cent under last year.



Eight large industrial building awards, four of which are for electrical generating facilities, two for oil refineries, and one each for steel plant expansion and shipyard construction, are largely responsible for the highest weekly industrial building volume since June 24, 1937. Commercial building and large-scale private housing reached its third highest week of the year. In addition to these two classes of work, waterworks, bridges, streets and roads, and unclassified construction top a week ago; and waterworks and unclassified exceed last year.

New capital for construction purposes for the week, $38,538,000, is 29 per cent below the volume for the corresponding 1938 week. The current week's financing is made up of $28,684,000 in USHA loans for low-rent slum-clearance projects in 13 cities, $8,440,000 in state and municipal bonds, and $1,414,000 in corporate security issues.

New construction financing for the year to date, $2,223,476,000, is 31 per cent under the $3,217,577,000 for the corresponding 1938 period.

(Weekly table on page 35)

Constructors Meet In New York

Hold Construction Day at World's Fair with 200 representatives attending

Braving a cold drizzle, nearly 200 persons representing various branches of the industry attended the Construction Day program at the New York World's Fair on Oct. 3 at which five speakers were heard. A paper prepared by John P. Hogan, former chief engineer of the Fair, told of the engineering and construction organizations set up to create the physical features.

Thomas S. Holden, president of the New York Building Congress, pointed out that the fair revealed several basic factors in building demand; transportation facilities and the rural development brought about by the automobile; expansion of public works for better living; industrial development; and better and adequate housing facilities. Contributions to the field of lighting made by the fair, according to R. C. Engleken, lighting specialist, include a practical development of fluorescent lights and mercury capillary or mercury arc lights.

In his paper "A Builder Looks Ahead" Arthur C. Tozzer, vice-president of the Turner Construction Co., dwelt at length on the new conception of labor relations. All contractors, he said, despite harassing experiences of the past, must maintain a policy toward workers which not only recognizes their rights, but expects and demands that labor accept its share of responsibility for the general welfare of the industry.

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(News Continued on p. 94)

ENGINEERING CONSTRUCTION CONTRACTS REPORTED BY ENGINEERING NEWS-RECORD, IN SEPTEMBER, 1939

Engineering News-Record *reports projects of the following minimum costs: — water-works, excavation, drainage and irrigation,* $15,000; *other public works,* $25,000; *industrial buildings,* $40,000; *other buildings,* $150,000.

Four Weeks — Thousands of Dollars (000 Omitted)

Public Works	New England	Middle Atlantic	South	Mid West	West of Mississippi	Far West	United States Sept. 1939	United States Nine Months 1939	United States Nine Months 1938	Canada
Waterworks	242	390	596	1,590	408	198	**3,424**	143,466	83,522	876
Sewerage	788	5,767	.....	3,341	2,641	359	**12,896**	127,390	80,915	.....
Bridges, public	546	596	1,926	1,663	1,411	1,258	**7,400**	118,004	80,537	155
Earthwork and waterways	4,435	627	5,043	787	8,667	1,653	**21,212**	168,990	207,327	759
Streets and roads	2,081	16,433	5,460	7,671	10,087	6,418	**48,150**	493,184	486,604	4,718
Buildings, public	4,337	11,765	3,988	2,481	3,391	2,330	**28,292**	469,344	278,866	1,477
Unclassified, public	389	5,683	692	14,975	1,596	1,551	**24,886**	135,068	144,674	774
Total public	**12,818**	**41,261**	**17,705**	**32,508**	**28,201**	**13,767**	**146,260**	**1,655,446**	**1,362,445**	**8,759**
Federal government (included in above classifications)	5,324	2,680	6,559	1,556	10,321	6,454	**32,894**	251,787	261,960	.....
Private										
Bridges, private	.....	73	.....	.....	284	.....	**357**	5,238	5,551	.....
Buildings, industrial	4,728	3,686	2,842	6,543	4,880	1,890	**24,569**	170,910	115,742	448
Buildings, commercial	1,850	10,192	500	4,520	1,110	1,310	**19,482**	277,532	451,158	1,975
Unclassified, private	319	4,264	2,665	3,706	7,400	315	**18,669**	156,126	64,864	820
Total private	**6,897**	**18,215**	**6,007**	**14,769**	**13,674**	**3,515**	**63,077**	**609,806**	**637,315**	**3,243**
Total Engineering Construction										
September, 1939 (4 weeks)	**19,715**	**59,476**	**23,712**	**47,277**	**41,875**	**17,282**	**209,337**	.....	.....	**12,002**
August, 1939 (5 weeks)	13,445	104,525	38,811	57,338	59,163	37,940	**311,222**	.....	.....	14,042
September, 1938 (5 weeks)	16,836	108,788	27,184	55,626	46,471	34,820	**289,725**	.....	.....	6,215
Nine Months — 1939	125,759	734,491	330,677	436,977	413,068	224,280	.....	2,265,252	.....	91,671
Nine Months — 1938	95,258	790,874	193,889	264,909	341,593	313,237	.....	.....	1,999,760	63,479

COMMENT AND DISCUSSION

Readers' opinions on matters that concern the engineer

Unusual Foundations For Brookline Tank

Sir: In the article describing the spheroidal water storage tank at Brookline, Mass. (*ENR*, Aug. 31, 1939, p. 291) reference is made to the method of supporting the flattened bottom of the tank on the ground. It might be of interest to add that the reinforced concrete slab under the gravel fill and sand cushion is divided into four sectors in plan and each sector sloped to drainage outlets located at quadrant points along the outside foundation ring wall. In the event of leakage of the tank bottom, it was thought that the general location of the leak could be determined by inspection of the drainage outlets, which are visible outside the ring wall.

I should like to add also that the writer served as consulting engineer and designed all foundation work, drainage and supply lines for this project in collaboration with Walter B. Bushway, superintendent of the Brookline Water Board, and Messrs. Little & Russell, architects.

MAURICE A. REIDY
Boston, Mass.

Length of Parabolic Arcs

Sir: In my discussion of formulas for lengths of parabolic arcs (*ENR*, July 20, 1939, p. 42) the parabolic formula should read

$$S = L + \frac{8\,k^2}{3\,L}$$

I regret that on the typed copy sent you, a minus sign was used in error.

PAUL E. MAGERSTADT
San Francisco, Calif.

Simple Arc Formula

Sir: In the April 13 and July 20 issues of the Engineering News-Record appear communications regarding the length of parabolic arcs.

Although probably not the first time it has been derived, I have worked out a formula for the exact value of a parabolic arc which is much easier to use than those given in the above communications, or by any other writer, which I have seen.

Let $L = \frac{1}{2}$ span
$K =$ rise
$S =$ length of parabolic arc

Then $\frac{2K}{L}$ = tangent of ϕ, the angle between the horizontal and the tangent of the arc at end of span.

The exact formula for arc is

$$S = L \left\{ \sec \phi + \cot \phi \log_e \tan \left(\frac{\varphi}{2} + \frac{\pi}{4} \right) \right\}$$

or, using common logarithms

$$S = L \left\{ \sec \phi + 2.3025851 \cot \phi \log \tan \left(\frac{\varphi}{2} + \frac{\pi}{4} \right) \right\}$$

[log 2.3025851 = 0.3622157]

The exact values for span and rise given in the July 20 issue are as follows:

Span	*Rise*	*Arc*
2000	50	2000.854
"	100	2003.331
"	150	2007.476
"	200	2013.256
"	300	2029.606
"	400	2052.121

It should be noted that the sign, —, in the approximate formula, July 20 issue, should be +.

H. F. JOHNSON
Detroit, Mich.

Continuous Beam Design

Sir: The suggestions for the design of continuous concrete beams which I. E. Morris gives on page 203 of your Aug. 17 issue are excellent in principle, but they do not provide enough negative steel. A fully-restrained beam of one span under uniform load will be subject to an end moment of 0.667 $wl^2/8$ or 11 per cent more than he gives. In a fully restrained beam of two spans, the same moment will be developed when both spans are loaded; but the decimal coefficient for the end support becomes bigger if only one span is loaded: it becomes still larger if the other span is shorter; and larger again if the shorter beam is made shallower; with a possible limit of 1.00 if the short beam is small enough and if there is no column restraint at the middle support.

Even this is not the maximum, because it increases again if the larger beam is haunched at the end under consideration.

Corresponding positive moments may be calculated when suitable negative moments have been chosen, but some extra steel should be used to provide for the possibility that the assumed restraint conditions may not in fact be developed.

J. B. MACPHAIL
The Shawinigan Engineering Co., Ltd.
Montreal, Canada

Bolted Timber Joints

Sir: The article on "Strength of Bolted Timber Joints," by J. A. Scholten of the Forest Products Laboratory (*ENR*, May 11, 1939, p. 660) contains one statement which is subject to correction. Tabulated safe loads for bolts as determined by the U.S.D.A. Technical Bulletin #332 were presented as early as 1935 in the form of Supplement #2 to Wood Structural Design Data, published by the National Lumber Manufacturers Association of Washington, D. C.; in 1937 as Supplement #1 to the Douglas Fir Use Book, published by the West Coast Lumbermen's Association of Seattle, Washington; in 1937 in the Uniform Building Code published by the Pacific Coast Building Officials Conference, and also in 1937 in Appendix A of the Regulations of the Division of Architecture, State of California.

The supplements referred to above, which are available on request from the publishers, contain a considerable amount of information from Bulletin # 332 and elsewhere, which was not published in Mr. Scholten's article, and present the safe load values for both rough and dressed sizes of lumber.

A. C. HORNER
Timber Engineering Co. of California
San Francisco

Publicity for Engineers

Sir: In your Aug. 17 issue, p. 226, Farley Gannett asks, "Why So Few Famous Engineers Today?" The answer to this question may be found in that same issue of *ENR*. For ex-

ample, the article by Mr. Moisseiff, in giving a resume of knowledge of suspension bridge analysis, shows this clearly. In the whole article *not a single name appears* outside of the author's.

When speaking of the Manhattan Bridge, why not mention Johnson, Bryan and Turneaure? When speaking of the Deflection Theory nothing is said of Melan. He passes the George Washington Bridge saying . . . "strikingly brought forth to the engineers. . . ." and doesn't mention Ammann. In several places in the article he could have mentioned George E. Beggs, Modjeski, himself and others.

If engineers do not state who accomplished these remarkable achievements, how can we expect the general public to become acquainted with the famous engineers?

I always remember how ignorant I was when I was a student at Princeton and a great admirer of the Pulaski Highway. The day after the said highway was inaugurated, the *New York Times* published an account of the ceremonies. It occupied almost a full column, which was dedicated to describing the officials present, the public, the ribbon-cutting and even the automobiles present.

At the very end in a single separate line, added as a sort of unimportant footnote, they stated that "the highway was designed by Sigvald Johannesson."

J. A. VARELA
Montevideo, Uruguay

Rugged Transits

Sir: Reference is made to portrait of pioneer James Brindley. *ENR*, Aug. 17, 1939, p. 227. This picture haunts us. Can you assure us that instruments were sufficiently rugged, years 1716-1772, to support the tired engineer? This would help, as otherwise we will go on mentally hovering in futile anguish, unable to extricate the instrument from beneath the bulk of Brindley.

L. MEAD HAMMOND
Arlington, Va.

The Highway Spiral

Sir: The article by Prof. C. C. Wiley entitled "The Bugbear of Spirals" in *ENR*, Sept. 14, 1939, was read with considerable interest. Certainly no one can take issue with the well worded statements regarding the desirability of the universal adoption of transition approaches for highway curves. I cannot, however, agree with Professor Wiley's diagnosis of the reason for their neglect. Compact and relatively simple tables, giving details of the spiral only, have been available for nearly forty years, yet highway engineers have not used them very extensively. The reasons, in my humble opinion, are reluctant to change existing practices and to revise standards; a belief that a vehicle using a highway is not confined to a track and is able to effect the change from a straight to a circular motion smoothly; a belief that widening at a sharp curve, together with the gradual attainment of this widening accomplishes a satisfactory transition; and a reluctance and, frequently, inability to indulge in the trigonometric trial-and-error calculations required by the compact simple spiral tables to design a curve with transitions or adjust a simple curve to one with transitions.

The party chief in the field and the designer in the office are initially confronted with the problem of fitting a curve between tangents with a known deflection angle to certain location controls, generally the external distance, tangent distance or both. If he is to be encouraged to provide a curve with transitions, he should not be required to resort to trial-and-error calculations which keep the rest of the party waiting and which generally result in odd values of the degree of curve and length of transition. He should be provided with tables which give the answer at once and give a wide range of combinations of degree of curve and length of transition. Such tables have been prepared by the U. S. Public Roads Administration and now are for sale by the Superintendent of Documents.

I wish particularly to correct the inferences that in *ENR*, Sept. 8, 1938, I claimed originality for developing a formula for transitions and that I did not consider the resulting length a minimum. The formula is based on rate of approaching centripetal acceleration, which is purely a geometric derivation original with neither Professor Moyer nor myself. As to the length of spiral, the fact that they are considered minimum is borne out by the tables referred to, of which I am the author, which give a wide choice of lengths longer than the minimum.

The question of length of spiral is a moot one and few data regarding the most desirable length resulting from research and experience are available. Professor Wiley refers to "a study of existing curves and driver behavior" in this regard. If this study is scientific and comprehensive, it is unique and should be given wide publicity to invite constructive criticism. It is suggested that it be submitted to the Project Committee on Relation of Curvature to Speed of the Highway Research Board. Professor R. A. Moyer is chairman.

JOSEPH BARNETT
Senior Highway Design Engineer
U. S. Public Roads Administration

Forgotten Inventories Of American Waterworks

Sir: Without disparaging the valuable *Inventory of Water Supply Facilities* published in your issue of Sept. 28, 1939, permit me to note an oversight in the editorial paragraph calling attention to the inventory: "Thus there is now available for the first time a complete picture of the status of water supply in the United States."

Engineering News published far more comprehensive summaries for both the United States and Canada, first in its pages, then as Introductions to its Manual of American Water-Works for 1888, 1889-90, 1891 and 1897. That was so long ago that no wonder they were forgotten or overlooked by the youthful editors of *Engineering News-Record*.

M. N. BAKER
Ancient Editor,
The Manual of American Water-Works
Associate Editor, (Retired)
Engineering News-Record
Upper Montclair, N. J.

[No one, not even the *youthful* editors of *ENR*, would fail to consult the works of the dean of American waterworks writers, M. N. Baker, before attempting to pass judgment. Thus it was that in writing our preface to the *Inventory* we first looked into the *Manual* of 1888 and discovered the following statement: "While the publishers feel that they have reason to be well satisfied with the present volume . . ., it is necessarily not as complete as it will gradually become." However, the task of making our *Inventory* complete cannot be compared with Mr. Baker's prodigious task on the *Manual*.—EDITORS]

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OCTOBER 12, 1939

HARASSED CONTRACTORS and owners hailed the action taken two months ago by the Building Trades Department of the A. F. of L. to end jurisdictional disputes, but even the most optimistic did not expect the millennium of complete cessation of these exasperating inter-union squabbles. However, reports made at the A.G.C. meeting last week are most encouraging. Immediately following the announcement of the jurisdictional peace plan in August more than 300 existing disputes were settled, and numerous disputes originating since then have been disposed of in a few days. Admittedly some jurisdictional troubles exist and they apparently defy all attempts at settlement, but progress is being made even with these knotty problems, as witness the recent truce in acoustical materials where the carpenters, bricklayers and plasterers temporarily divide the work. Top labor leaders are showing an earnest desire to wipe out the jurisdictional dispute. Contractors breathe a fervent prayer that recent progress means they will some day be successful.

A Promising Method

AN INNOVATION in Chicago's common method of sinking foundations through the deep clay beds that underlie that city is described in this issue. Instead of sinking small caissons to rock by hand excavation, shafts 5 ft. in diameter are sunk with great power-driven augers. Jets feeding to the cutter-head make a slurry of the clay and force it up the shaft to the surface, and when rock has been reached the hole is filled from the bottom with tremie concrete. A test shaft sunk by this method made a satisfactory showing, but as the complete method has not been approved by the building code authorities of Chicago it has been modified to keep within the code requirements in subsequent work. As modified, the method still appears to hold advantages over the old method. It remains for the promoters of this new method to convince the building code authorities that the complete method is safe, specifically that tremie concrete placed under such conditions can be made satisfactory as a routine matter. And on the code authorities rests responsibility for not carrying caution to the extreme of limiting progress in the use of new methods of construction.

Basic Qualities

ENGINEERING ACHIEVEMENT usually depends as much on keen observation as on intuition and imagination, for without the material provided by the former the creative thought would be of little effect. The late Thaddeus Merriman was distinguished as much by his power of observation as by his creative intuitions. It is well worth remembering that through them he accomplished his most important service to the community—his conception of a plan that would permit New York City to take water from the headwaters of the Delaware and still respect the rights of Pennsylvania and New Jersey. But this quality was evident also in his fundamental work on cement, and most recently in his challenging analysis of the great slump in the Fort Peck Dam. The work on cement is likely to remain unknown to the general public, but engineers look forward to improvement of the material as the result of his findings. Most recently the strength of his clear and independent thinking came to view in the Fort Peck inquiry. The differences of judgment that surround the problem of the big dam cannot dim the excellence of his study; in unusual degree it sprang from observation and an understanding of how physical conditions may affect theoretical conclusions, qualities on which the engineer will always depend.

Suppose It Had Been Arsenic?

CROSS-CONNECTION HAZARDS in water distribution were dramatically demonstrated at Cleveland a few days ago (*ENR*, Sept. 28, 1939, p. 389) when a city water main was found to be clogged with paraffin! Investigation revealed that someone at an oil refinery had made a "mistake" and turned liquid paraffin into the water main instead of a refinery line. The pipes clogged included 600 feet of 8-in. main and a great length of 6-in. pipe. In other words the paraffin travelled a long way and affected the supply of a great many people before it was discovered. Suppose arsenical wastes or some other toxic substance from an industrial plant had been turned into the water main "by mistake"? Instead of clogged mains Cleveland would have had clogged mortuaries. Where would the respon-

sibility for such a tragedy lie—on the conscience of the man who made a "mistake" or on the municipality that failed to discover cross connections which permitted such mistakes to occur?

Disaster But Not Defeat

ONE OF THE MOST courageous bridge building attempts in history met disaster last month when a partly completed concrete arch of 866-ft. span crashed with a tangled mass of timber centering into the waters of the Angerman River in Sweden. Not since the Quebec Bridge collapse of 30 years ago has such a spectacular bridge accident occurred. As at Quebec, here was the longest bridge of its kind in the world. Also, as at Quebec, the collapse occurred when the bridge was under construction and resulted in the death of a large number of workers. On the other hand, no part of the Angerman River concrete arch failed; its construction had only started, and it was the timber centering that proved inadequate. Despite the inclination of American engineers to look to steel for such long spans there is no concealing their admiration for such great concrete arches as have been built in Europe, notably the 612-ft. span at Brest, France, and the 593-ft. span at Stockholm, Sweden. Our own longest concrete arch is the 460-ft. span Westinghouse Bridge at Pittsburgh, so that the 866-ft. span designed for the Angerman River crossing is beyond easy comprehension. Yet Freyssinet, who built the Brest bridge, has proposed 1,000-ft. concrete spans more than once. Now that Swedish engineers have dared to jump the maximum concrete arch span length as much as 40 per cent it is to be hoped that their next attempt be entirely successful.

Underground Water

THE FIRST ATTEMPT to adjudicate apportionment of the underground waters for an entire basin among the overlying landowners has been begun in Southern California, as reported on p. 64 of this issue. Drafts now are made on the supply without regard for its possible exhaustion under a water-right doctrine laid down in 1903 when the underground supply was looked upon as unlimited. Fortunately, engineers have been brought in at the early stages of the pending legal battle. The court has asked engineers of the state Division of Water Rights to clarify the facts upon which its decision must be based and the large landowners involved also have engaged engineers as consultants. These men can be counted on to define the limits of the underground basin and to determine what drafts can be made without depletion of the supply, thus giving the court a factor to use in apportioning the water. Thus engineers have been given an opportunity to write engineering principles into a water-right doctrine that may have a far-reaching effect.

Emergency Contracts

WAR in Europe is threatening to disrupt normal contracting procedure in this country, for every construction contract is a long-time commitment on labor and materials. In time of war both the supply and cost of these two elements becomes uncertain. Further, not only the means of construction but the life of the project also becomes an uncertainty, for developments in the emergency might result in abrupt termination of the job. Thus contracting is facing a most uncertain period.

The best interests of the public, private owners and contractors would be met by the development of some form of workable contract that would distribute the uncertain risks. Of course, the contractors could take all the risk, but the owner would pay a high insurance rate in increased costs, probably beyond the true value of the work. Again, the owner might assume all responsibility for increased costs during the life of the contract, but such a course eliminates most of the need for a contractor; he would become merely a labor agent and skilled supervisor of construction. Many public agencies as well as private owners, under such circumstances, would do their construction by day labor, a possibility that offers a serious threat to the contract system. A middle course of some kind holds promise of benefit for all concerned.

The middle course appears to lie in contracts with provision for price adjustment in case of major labor and material costs changes, such as contracts with the owner sharing all cost rises or those above a certain range; contracts in which the owner bears all cost rises up to a certain point, thus setting a top cost to him, and the contractor taking all the risk above that agreed amount; or, finally, various kinds of cost-plus contracts.

There are enough brains in the construction industry to work out an equitable contract for this emergency period. True, change in public works procedure may meet with legal difficulties, but in times of emergencies, unusual action is justified. Certainly some means can be found to preserve the benefits of the contract system and yet protect contractors against ruinous loss in case of unpredictable circumstances.

FIG. 1. ROSS DAM, THIRD STEP IN SEATTLE'S HYDRO-ELECTRIC DEVELOPMENT OF SKAGIT RIVER.

Ross Dam Built in Isolated Skagit Gorge

***Contents in Brief**—Ross Dam, third step in Seattle's municipal hydro-electric development of the Skagit River, is being built in an isolated gorge at the head of Diablo Reservoir. Present construction is first of three stages in ultimate building of a high dam and a power plant. Men, materials and equipment are transported to the site by boat on Diablo Reservoir, only access to the job. Cableway, suspension bridges and belt conveyors are part of interesting construction plant.*

IN A NARROW, ISOLATED GORGE high in the Cascade Mountains in northwestern Washington and far beyond railroad or highway transportation facilities, the City Light Department of Seattle is building the first stage of Ross Dam (formerly Ruby Dam), start of its third hydro-electric development on the Skagit River. It is an interesting and unusual project, both in design and construction. The present work is the lower half of a high, variable-radius concrete arch dam, which will be completed in the next construction stage. Then, some time in the near future, the arch dam will be incorporated into a curved gravity-section dam 653 ft. high. This final stage of the project will include a power plant of 480,000 hp.

From a construction standpoint the present job is interesting because of the locale and difficulty of access. Everything for the project—men, materials (except aggregates), equipment, tools and supplies must be transported over the City Light's own railroad from Rockport, Wash., to the present Diablo Dam power plant, hauled up a steep incline and transferred to boats for a 5-mile trip across Diablo Reservoir to the Ross Dam site in the Skagit gorge at the head of the reservoir. At the site there is little room for plant and equipment. The compressor house is perched on a rock island in the gorge, the concrete plant is hung on the side of the gorge, the cableway head tower rises on a crib-retained fill tied back to the canyon wall, and aggregates, coming from a gravel bar three miles upstream, are processed in a plant on the side of the canyon and are delivered to the job by an elaborate belt-conveyor system over a suspension bridge. Access roads at the job have been carved out of canyon walls, are carried on trestles and cribbing, and cross the gorge on a high suspension bridge.

City Light's first development of the Skagit River was the Gorge Plant.

23 miles above Rockport, completed in 1924. This plant, with a capacity of 75,000 hp, uses the run of the river, with dry-season help from Diablo storage, by means of a low diversion dam and a diversion tunnel 11,000 ft. long. The head on this plant will some day be increased from 285 to 385 ft. by construction of a new higher diversion dam. The city built a standard-gage railroad from Rockport to the site for construction purposes. The next step in the Skagit development was Diablo Dam (completed in 1930), seven miles above the Gorge Plant, and the Diablo Power Plant, completed in 1937 with an installed capacity of 160,000 hp, which can be doubled by adding two more units. The railroad was extended to Diablo Dam during its construction, and this section is all-electric operation, for the grade is too steep for steam locomotives. Rail access to the top of the dam was provided by a 68-per cent grade cableway incline, 313 ft. high, capable of handling loaded standard-gage cars. Prior to start of Ross Dam operations the contractor built a half-mile of railroad from the top of the incline to a landing stage on the shore of the reservoir.

The site of Ross Dam is most ideal for a concrete dam. Just above the headwaters of the Diablo Reservoir the Skagit valley again narrows to a deep gorge with almost precipitous sides. Foundation investigations revealed a deep depression in the bedrock—a perfect toe-hold for a high dam. The first two stages of development call for a variable-radius arch dam 425 ft. high, rising from the lowest point at El. 1,075 to El. 1,500. The present first stage of construction

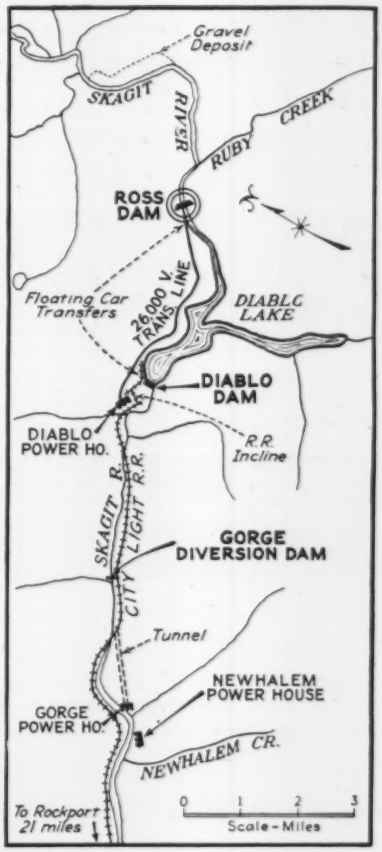


Fig. 3. Map of Seattle City Light hydro-electric developments on Skagit River. All transportation to Ross Dam is by rail and incline to top of Diablo Dam, then by boat full length of Diablo Lake. Newhalem plant, shown here, is a small unit built to supply power for construction of Gorge Plant.

Fig. 2. Space for construction plant at Ross Dam was carved out of side of canyon or built up of timber cribbing and trestles. This is a view looking downstream; upper cofferdam and tunnel intake in the foreground.

is for the lower half of this dam, stopping at El. 1,350, requiring 310,000 cu.yd. of concrete. The present contract, which also includes a 15-ft. timber dam on top of the concrete, will impound 75,000 acre-ft. that will be helpful in regulating the streamflow in dry months. When the crest is raised to El. 1,500, more than 506,000 acre-ft. will be impounded, of which 500,000 will be usable storage. Some 329,000 cu.yd. of concrete will be required for the second stage. This storage will help the two projects downstream. The arch dam, a good-sized structure in itself, will ultimately be a small part of the final dam, of curved gravity section, to be built to El. 1,728, or 653 ft. above the foundation. This third stage requires 2,400,000 cu.yd. of concrete. Keys and steps on the base and top of the arch will bond the two structures (Fig. 1). A cross-section sketch of the progressive stages of construc-

tion is shown in Fig. 4 on this page.

The high dam project includes a power plant installation of 480,000 hp. A reservoir 30 miles long, storing 3,200,000 acre-ft. of water will be created by the dam. Accounts of previous phases of the Skagit River project have appeared in *ENR*, Dec. 8, 1921, p. 948; Nov. 18, 1924, p. 995; Aug. 29, 1926, p. 320; Oct. 14, 1937, p. 633 and Feb. 16, 1939, p. 218.

River diversion

River control for the present construction stage is by a 32-ft. diversion tunnel 967 ft. long. For control in the immediate future, an adit has been driven from a point just upstream from the right abutment to intersect the tunnel about midpoint and two 6-ft. steel pipes, equipped with Broome gates, are to be placed in this adit. When these are ready, the tunnel will be unwatered and plugged temporarily above the junction of tunnel and pipes. This outlet, together with two temporary openings through the dam at El. 1,284, will be used to control the stored water during the time between the first and second stages.

For future construction, the plug in the tunnel will be opened, thus utilizing the present diversion tunnel for the second stage. After the completion of the second stage the tunnel will be plugged permanently and control of the flow into Diablo Lake will be accomplished by use of the Broome gates and a combination of a needle valve and a butterfly valve in the adit, also through two 6-ft.-diameter pipes through the dam at El. 1,340 with two Broome gates and a combination needle and butterfly valve arrangement on the downstream end of the pipes. At the start of the third stage (high dam) another diversion tunnel will be driven at El. 1,450 for flood control only; releases for downstream plants will be through the controls at lower levels. During this construction, openings will be left in the dam above El. 1,480 for flood control until the permanent spillway is built.

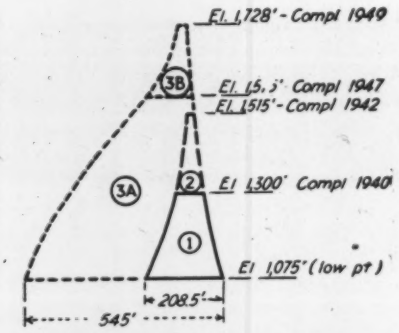


Fig. 4. Ross Dam will be built in three stages; eventually it will be second highest in the world.

Construction attack

The city had built the railroad to the shore of Diablo Lake just a tenth of a mile above Diablo Dam, and a 26,000-volt transmission line from Diablo plant to the Ross Dam site—after that the contractor was on his own. Contract was awarded in July, 1937, to the General-Shea-Columbia Construction Co. for $3,968,000.

The first thing the contractor had to do was to provide landing facilities at the railhead on the reservoir near Diablo Dam and to put barges and a tug on the lake. Then a well-equipped, comfortable 300-man camp was built at the head of the lake, 2,000 ft. below the new dam site. Later, facilities were installed at the rail-head for transfer of freight cars to a car ferry.

The second step was to clear the north side of the gorge to make room for access roads and for the various plant items. Hand drills and portable compressors were used for the early stages of this work and as space was provided bulldozers and a dragline were brought in. Loose material was pulled down and pockets were blown out of the solid rock to provide space for equipment and a few level spots to work. Cribbing and trestles were used to support the roads. The first major plant to be installed was the compressor plant, located on jutting rock on the side of the gorge. With this important equipment in place, the diversion tunnel could be started.

Use of a truck-mounted drill carriage was the high spot in tunnel driving. Auto trucks were also used for muck handling, as the tunnel was fairly short and of large diameter. The tunnel was left unlined.

Difficulty was encountered in diverting the swift stream into the tunnel because of flash floods just when diversion operations were ready. Finally, the contractor threaded 1-yd. to 1½-yd. boulders on anchored

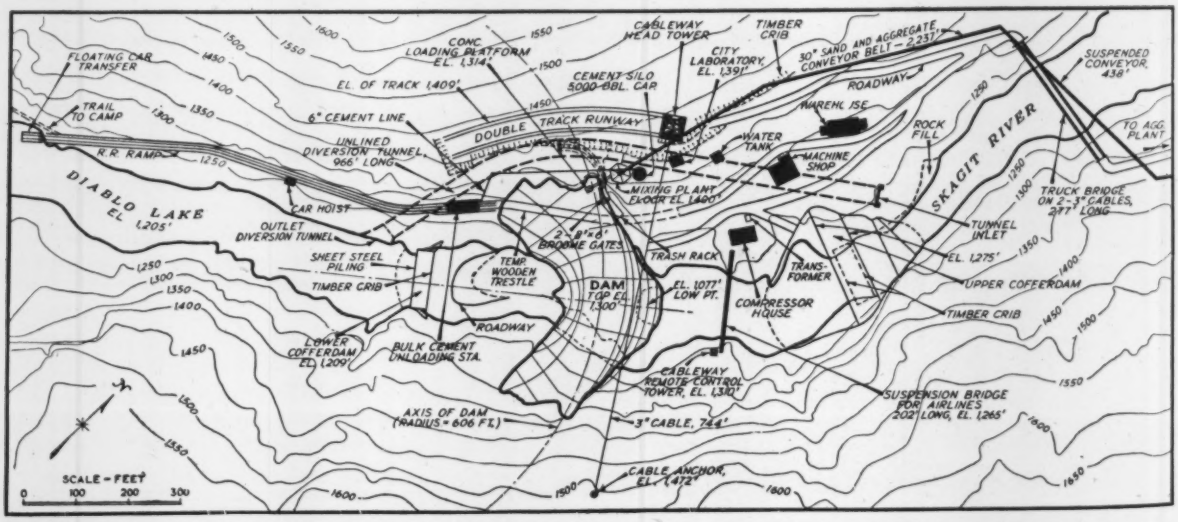


Fig. 5. Construction plant layout. Principal items are high-line cableway with traveling head tower, full automatic mixing plant, belt conveyor system for aggregate delivery and suspension bridges for trucks and conveyor.

cables, which, when placed in the stream, checked the current enough to permit placing of the diversion fill. The upstream cofferdam, built to El. 1,275, is a rock-filled timber crib, sealed by a sheetpile cutoff, and covered with a gravel-clay fill for water tightness. The downstream cofferdam is a rock-filled crib faced on the downstream side with steel sheetpiling, built to El. 1,209.

Except for difficulty in finding room for the head tower, the site is ideal for the use of a high-line cableway for placing concrete. By blasting out a cliff and building a lot of crib retaining wall to hold rockfill, the contractor managed to work out a level spot at El. 1,409 long enough for a traveling head tower to move 500 ft. A 75-ft. tower was built, using cable drive for traveling, carrying the main 3-in. cable line at El. 1,486. On the opposite side of the canyon, 744 ft. away, a fixed tail anchor was doweled to solid rock. This arrangement, with the head tower traveling in an arc, covers the entire dam except for one small section below the tail anchor. The head tower travels on double railroad tracks 45 ft. apart, which carry the vertical load only; the thrust is carried by a separate rail between the load tracks, anchored to the side of the canyon by heavy rods.

A 400-hp. slip-ring electric motor operating at 2,300 volts, handles the carriage travel and hoisting, while a 75-hp. motor moves the tower and a 25-hp. motor operates a compressor for air-braking. Besides the 3-in. "main gut" line, 744 ft. long, the cableway is equipped with 1,550 ft. of 1-in. rope for the tower travel, 1,675 ft. of $\frac{3}{4}$-in. endless line on the carriage and 2,900 ft. of $\frac{3}{4}$-in. load line.

The main feature of the cableway, however, is operation by remote control. Upstream from the dam and on the opposite bank from the head towers at El. 1,310, is the operating station. All movements of the cableway are controlled from this point, from which the operator has full view of all operations. The remote control system, designed and installed by the General Electric Co., has proved entirely satisfactory.

On the right bank shore of the lake, about 1,000 ft. below the dam, an adjustable platform has been installed for transfer of freight cars from barge to land (lake is El. 1,205). From this platform a railroad has been built on a 20-per cent grade to El. 1,269, where it levels off to an unloading station just below the dam, within reach of the cableway. Cars are hauled up and let down the ramp by cable and a 100-hp. motor (Fig. 9). At the top of the ramp the cars are picked up by a gasoline locomotive for movement to the unloading station. A similar cableway ramp was installed at the railhead at the opposite end of the lake.

Foundation excavation, largely removal of river debris and weathered rock, was carried out by shovels loading into trucks and by skips handled by the cableway. Trucks went in and out of the hole on a road built up the downstream cofferdam, thence over temporary trestles and roadways to upstream spoil banks. The skips were dumped into trucks on the trestles.

Concrete and aggregates

A suitable and adequate supply of sand and gravel was found in a bar in the river three and one-half miles upstream from the dam, where the gorge widens out to a narrow valley. To reach this bar the contractor had to build three and one-half miles of gravel road, on a maximum grade of 7 per cent, and three bridges, two across the river and one over Ruby

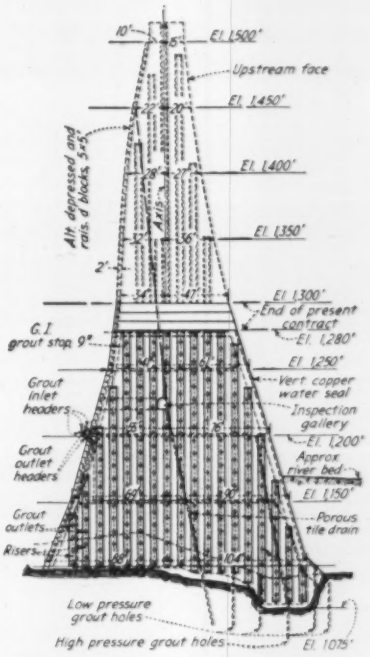


Fig. 7. First two stages of Ross Dam construction are a variable-radius concrete arch of this cross-section, eventually to be incorporated into a higher curved gravity section.

Fig. 6. Upstream view of operations at start of concrete placing. Note the trestles and timber cribbing necessary to provide space for plant items. Cableway headtower is behind cribbing at upper left.

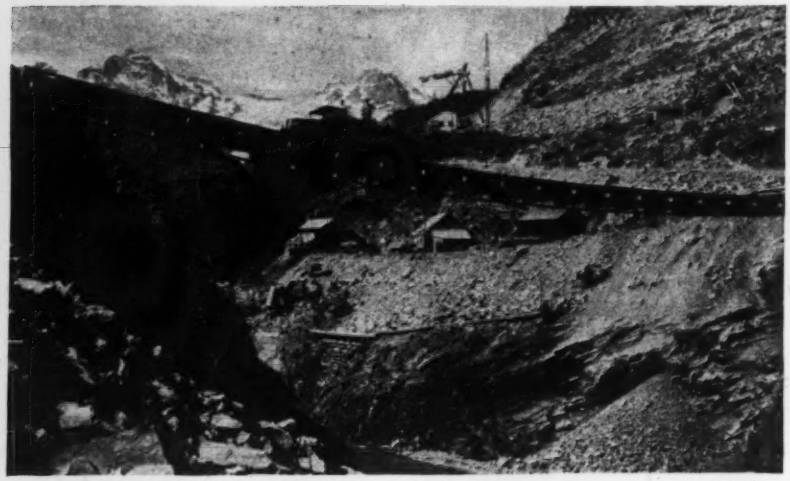


Fig. 8. Access to gravel plant and deposits is over this 20-ton deck suspension bridge, carried by two 3-in. cables.

Creek. The deposit is stripped by a heavy bulldozer, and the aggregates are dug by a 2-yd. gas dragline loading into a fleet of ten 8-yd. trucks for transportation to the aggregate processing plant, located on the left bank of the river about ½ mile above the dam. The trucks average two round trips per hour, working two shifts per day.

At the processing plant the trucks dump onto a raw storage pile over a tunnel 184 ft. long. A belt conveyor within the tunnel delivers the raw product to a primary and secondary crusher. Then the material goes through a series of screens and washers and finally to two belts for delivery to two storage piles in tandem, one for sand, the other for gravels. The final product is classified into sand and four sizes of gravel from

Fig. 9. A car of bulk cement leaves the transfer barge on Diablo Lake for a cable haul up the gorge at the dam.

$\frac{3}{16}$ in. to 6 in. Belt conveyors in tunnels under the storage piles deliver aggregate as required to a series of 30-in. belt conveyors, aggregating 2,237 ft. long, leading to the mixer plant, located at the dam on the opposite side of the gorge.

First in this series is a belt 808 ft. long from aggregate plant to the river crossing. This crossing is a belt conveyor 438 ft. long carried on a suspension bridge, one of the few installations of this type ever tried. Two more stretches of conveyors 475 and 332 ft. long, deliver the aggregates to proportioning bins at the top of the mixing plant, hung on the side of the gorge.

The mixing plant is equipped with full automatic batchers for each of the five sizes of aggregate, cement and water. Two 4-yd. tilting mixers, front charge and discharge, deliver mixed concrete to a hopper below.

All concrete is handled to the dam by an 8-yd. cableway bucket. This bucket is spotted on a platform below the mixer and is charged by a cable-operated car running on a short, steep incline between concrete storage hopper and the loading station. Concrete placement averages 2,000 cu.yd. per day. A complete round trip of the bucket takes from 4 to 5 min.

Bulk cement comes to the job in box cars. From the car barge transfer station these are hauled up the railroad ramp and spotted on a level siding at an unloading shed. Here the cement is unloaded by a portable remote-control unloading machine and pumped into a 5,000-bbl. silo alongside the mixing plant through a pipeline having a rise of 125 ft.

Other plant

For highway access to the gravel plant and deposits, the contractor built a highway suspension bridge, 277 ft. long, just above the upper cofferdam. This is a deck structure: 12x14-in. transverse timbers, 10 ft. apart, rest directly on two 3-in. cables anchored to solid rock. The decking is heavy planking laid longitudinally over the timbers. Hub-high timber curbs are braced to the supporting timbers. The bridge, of 20-ton capacity, is remarkably stable despite lack of stiffening members, sway bracing and guy wires.

Another 200-ft. suspension footbridge crosses the gorge near the upstream toe of the dam. This provides access to the remote control station of the cableway and carries air and water lines and floodlights. Other floodlights are placed around the sides of the gorge, and on the cableway highline. The job is well lighted for night work.

Electric power, coming from Diablo Dam at 26,000 volts, is stepped down to 2,300 volts at a job substation, and is further stepped down to 440, 220 and 110 volts by various transformers. The connected electrical load is 3,400 hp., which includes the cableway and incline hoist motors, numerous electric-drive pumps, the motors on the belt conveyors and at the gravel plant, the compressor motors and job and camp lighting.

Direction

The City Light Department staff was organized by J. D. Ross, superintendent, and was directed by him until his death last March. E. R. Hoffman is now superintendent, assisted by W. J. McKeen. Glen H. Smith was in charge of outside construction until his death Sept. 10, 1939. W. B. Wolfendale is principal engineer in charge of design and construction, B. E. Torpen is consulting engineer and Paul M. Trueblood is senior engineer in charge of design. At Ross Dam, C. G. Will is senior engineer in charge of construction and H. F. Faulkner is senior engineer in charge of concrete control.

For the contractor, General-Shea-Columbia Const. Co., C. W. Wood is general superintendent, assisted by P. P. Patton and A. J. Lewis.

Soil-Cement Revetment Moves

***Contents in Brief**—A river-bank revetment made of cement-stabilized soil in sacks held together well despite slipping of entire bank on underlying stratum.*

CEMENT-STABILIZED EARTH in sacks used for river-bank revetment at Ft. Brown, Texas, has held together well in the course of subsidence and a riverward movement of as much as 5 ft. which followed the summer floods. Methods of constructing this revetment, which was completed early this year, were described in *Engineering News-Record*, May 11, 1939, p. 659. What happened to the improvement after the flood, with as complete an explanation of causes as could be obtained, is outlined in the following:

Repeated flood stages of the river during May and June, in one of which the freeboard on the levee was only about 4½ ft., gave a satisfactory test of the revetment: it prevented all the bank cutting that ordinarily has taken place during floods.

However, as the last flood subsided, general settlement began in the bank between the levee top and the low-water channel and continued for about three weeks. Although similar movement has been observed in previous years the greater amount noted this year is ascribed at least partly to the load imposed by the revetment on the softened material.

A cyclic movement of the river bank is believed to be going on at this point. It floods the stream deposits silt on the shelf between the levee and the low-water channel. As floods subside the saturated prism settles or sloughs, this movement being manifest as subsidence along the landward fault line and as horizontal thrust nearer the river channel. River current at low stages cuts off the toe of the slide thus leaving the bank in an unstable condition when the silt load is again imposed on a bank soon left saturated by subsiding floods.

Considerable satisfaction has been found in the fact that despite the 5-ft. movements of the cement-stabilized revetment in both vertical and horizontal directions, the bags did not separate except where movement of underlying strata was such as to cause breaches. This gives basis for the belief that repairing and adding to the revetment, which may be done from year to year, should eventually develop permanent stability by stopping the toe cutting and the resultant cyclic movement.

Fig. 1. A 5-ft. settlement of bank and revetment did not disrupt continuity of the surface except where tree roots held the bags.

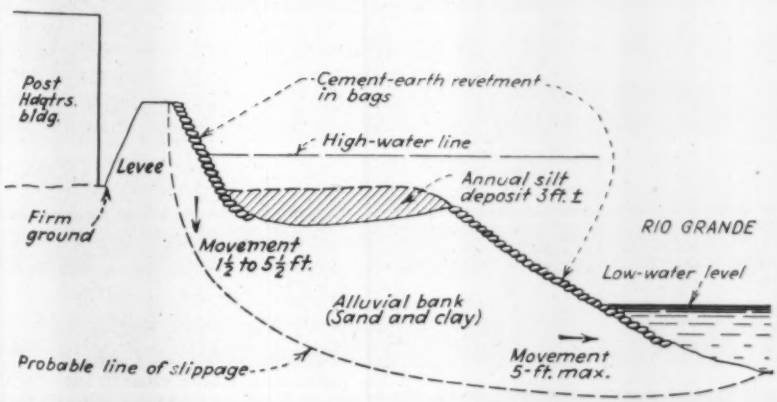


Fig. 2. Cross-section of the bank indicating the cyclic movement of the river bank during successive seasons.

Six-Year PWA Program Totals Six Billion

When the Public Works Administration on June 16 completed its sixth year of operation, it had included in its program 34,450 projects with a total cost of $5,950,502,000. Of this, $3,277,000,000 was federal money, including $1,507,000,000 in grants to 16,700 non-federal projects costing $4,185,000,000 and allotments covering the total cost of 17,790 federal projects amounting to $1,770,000,000.

More than 25,000 PWA projects have been completed at a total cost of $3,753,285,000 and about 6,800 projects with a total cost of about $2,187,000 are now under construction.

In its six year history, PWA Administrator Ickes announced, PWA has created 1,783,700,000 man hours of direct employment and, on the basis of Bureau of Labor Statistics studies, nearly 4,500,000,000 man-hours of secondary employment in the production of supplies and materials. In addition, PWA estimates that 3,580,000,000 man-hours of employment have been created in supplying the demand for consumer goods services as the result of direct and indirect employment created by the projects.

Tuning up Pressure Regulators

D. D. GROSS

Chief Engineer, Board of Water Commissioners, Denver, Colo.

Contents in Brief—Regulating valves have been used to great advantage in the Denver water system for controlling reservoir elevations and for pressure-reducing service. Methods of adjustment and inspection, and experiences in operation, form the background for this article.

WHEN THE NEW Moffat water tunnel of the Denver water-supply system was placed in service the conduits between the mountain reservoir and the city distributing system ere provided with twelve regulating valves of different types, together with auxiliary equipment for their operation. Adjustment of the ordinary regulating valve is not a difficult task, but at Denver, where the layout required a number of valves with more or less related functions, adjustment is more difficult. Also, operating conditions not primarily concerned with the valve itself frequently add to the problem of adjustment.

For instance, in putting the new conduit system into operation serious trouble was experienced in the adjustment of one of the valves on Conduit 16. After many endeavors to make the adjustment the pipeline was unwatered and a piece of reinforcing steel 30 in. long was found to have lodged in the valve, causing the difficulty. After removal of the bar, efforts were made to complete the adjustment to which the valve responded only in an indifferent manner. Placed in operation it seemed to perform its duties properly for a time, then the valve would close and considerable effort was required to get it open and functioning normally.

After a period of this trouble the pipeline was unwatered for another purpose, during which a second inspection was made. At this time another piece of steel was found, this being a ⅜-in. disk 6 in. in diameter cut from the steel pipe conduit itself at the time an air valve was installed.

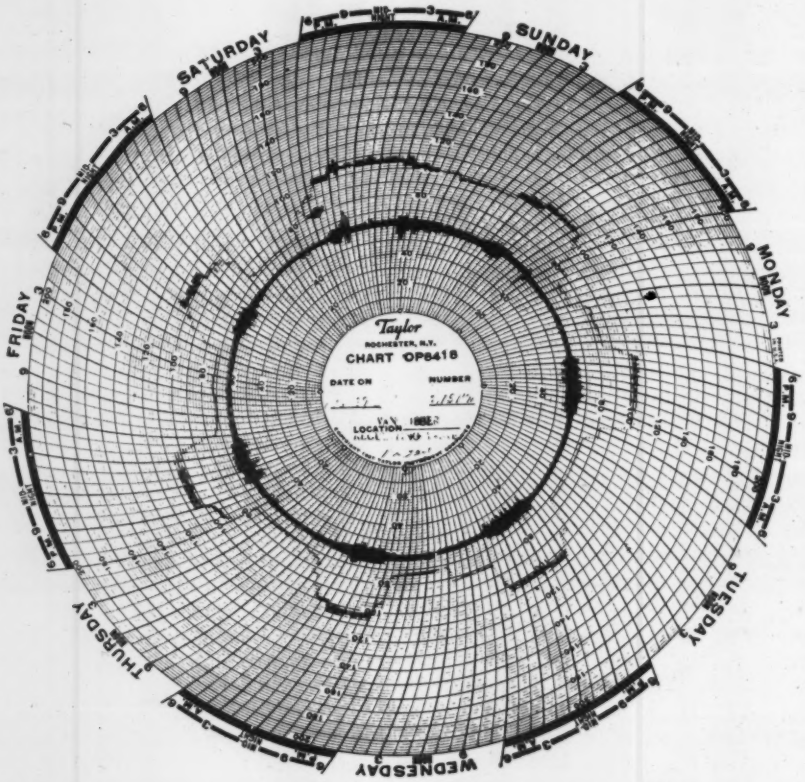


Fig. 1. A two-pen chart showing weekly operation of a 36-in. regulator valve in 42-in. Conduit 16. Maximum pressure on the high-pressure side of the valve is 106 lb.; regulated pressure on the low side of the valve is 60 lb., with the flow in the conduit varying from 10 to 60 mgd.

Desirability of dual valves

Experience proves that if care has been used to select the proper size of valve for the service to be performed, the adjustment (especially for small flows) is more easily accomplished and the valve is more reliable in its operations. If regulating valves are installed in position in which their failure to operate would deprive a considerable part of the distribution system of water, it is important that this fact be not overlooked in designing the setting for the regulating valve. In such case, two valves, preferably one larger than the other, make for a better setting than is the case if only one large valve is used. But the valve layout must be so designed that the smaller will come into service with the smaller flow of water and the larger will come into service automatically when larger flows are required.

Many of the adjustments on the regulating valve can be made with the valve in service. Some of these, however, cannot be so made, and furthermore the interior of the valve cannot be inspected with a flow of water in the pipeline. If the valve is in a position where closure will seriously interfere with service operations, then more than one valve should be provided and means of

closing off each valve to permit inspection and repair, should be provided.

The Denver practice is to make weekly inspections, checking and testing regulating valves as well as the auxiliary equipment. Inspections every seven days have proved satisfactory in maintaining a reliable service. In each regulator-valve vault a two-pen recording pressure gage is installed. One element of this gage is connected to the piping on the high pressure side of the valve and the other on the low pressure side. Seven-day charts are used on these valves, making it possible for the mechanics to change the charts at the time of their weekly inspection.

As equipped by the manufacturer, a common method of operating the regulating valve calls for the use of a small pressure reducing valve. This valve is installed to reduce the pressure of the water on the high pressure side of the large regulating valve to some fixed pressure which can be applied to one side of the diaphragm which operates the four-way cock that directs the flow of water into the cylinder, and which in turn operates the large regulating valve. With a uniform pressure maintained on the upstream side of the diaphragm, the diaphragm will move in response to the pressure on the downstream side. This causes the regulating valve to open or close as the case may require in order to discharge or limit the discharge of water on the low pressure side to such an extent as will maintain an equal pressure on both sides of the diaphragm, and hence give the required pressure on the system. However, variations in the upstream pressure at times hinder a uniform operation of this small reducing valve.

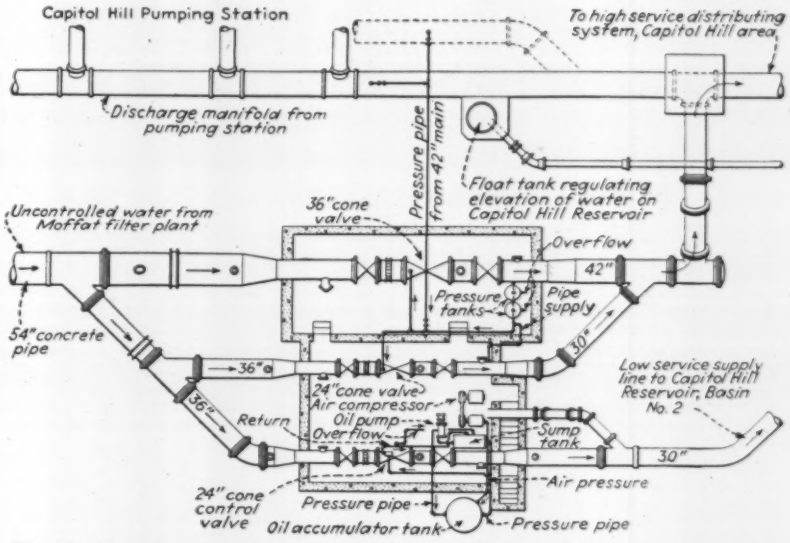


Fig. 2. Regulating valves and piping manifold connecting 54-in. Conduit 18 to discharge piping at Capitol Hill high-service pumping station and to Capitol Hill low-service reservoir. Regulator valves, 24 and 36-in., reduce the pressure from 100 to 68 lb. A third 24-in. regulator valve permits surplus flow to discharge into Capitol Hill reservoir if required but without depleting high-service pressure.

Fig. 3. Installation of regulator valves in 51-in. branch of Conduit 17, 33-mgd capacity. The 36-in. regulator is not visible but the 24-in. regulator is shown, also piping for the relief valve in the center foreground. The relief valve has not been installed. Piping for the vacuum breaker is shown in the center background.

causing "hunting" in the operation of the large valve.

Mechanics in the department have discovered what appears to be a better method of operation than the use of the pressure reducing valve, and that is to provide a pneumatic tank. A tank of 80-gal. capacity is connected to receive a water supply from the conduit from the high pressure side of the regulating valve. A second pipe leads from the pneumatic tank to the upstream side of the diaphragm controlling the operation of the large valve, the connection being so placed that when in operation no air will enter either of the pipe connections from the pneumatic tank. Water is introduced from the high pressure side of the regulating valve until the desired pressure is obtained on the pneumatic tank. The water supply is then shut off and the fixed pressure in the pneumatic tank is depended upon to operate the diaphragm; the remaining chain of operations is as originally planned. With a tank of this size used with the size of diaphragm occurring on the regulating valves in use in Denver (varying in size from 24 in. to 42 in.) it has been found that the pneumatic-tank plan of operation is much more satisfactory than the use of a small pressure-reducing valve.

The modern pressure-regulating valve, for use both in the conduits and city distributing system, is a very useful addition to the equipment of the water plant. Its use makes for both efficiency and economy in design and operation, and it solves many problems for the waterworks man. But the introduction of machinery of this nature into the water system piping brings with it a series of new duties and problems.

Thirty-five years ago regulating valves were rather cumbersome, unsatisfactory pieces of equipment that went about their work in a noisy, inefficient manner. Today's equipment is reliable, efficient and will regulate pressures within 2 lb. This type of equipment can be used to advantage in a number of situations, of which Denver has found some of the more useful to be the control of the elevation of water in reservoirs, as well as for pressure reducing service. The latter finds application in large areas of the city supplied from a conduit with the pressure considerably higher than would be desirable for distribution in the district; through the use of a regulating valve that pressure is brought to a desirable figure. Quite as important also is the use of the valve as a means of relieving pressure when excess pressure has been built up on any part of the distributing system, but particularly on a supply conduit.

Small Area Runoff Studied

C. S. BENNETT

Engineer, The Miami Conservancy District, Miami, Ohio

A SEVERE LOCAL STORM on July 29–30, 1939, produced an exceptionally high peak runoff on a small drainage area in southwestern Ohio. Due to the existence of a high road embankment across the stream near the area's outlet, it was possible to secure data from which the maximum rate of runoff could be computed.

The area involved is Brush Creek, a small tributary of the Stillwater River about 15 mi. north of Dayton, Ohio. The drainage area of this creek is 16 sq. mi. On the map (Fig. 1) are shown the location of this stream and adjacent rainfall stations.

The thunderstorm of July 29–30 apparently centered over the Brush Creek area. While no rainfall stations exist directly in this basin, the one at West Milton is only about 21 mi. west of the creek. Tipp City and Troy are respectively 7 mi. southeast and 8 mi. northeast of the area. A recording rain gage is located at Troy; the others are standard 8-in. Weather Bureau gages. The rainfall at West Milton began at 9 p.m. and continued with almost uniform intensity until 12 m. The total catch in this gage was 4.05 in., but at Troy only 2.73 in. was found and at Tipp City 1.08 in.

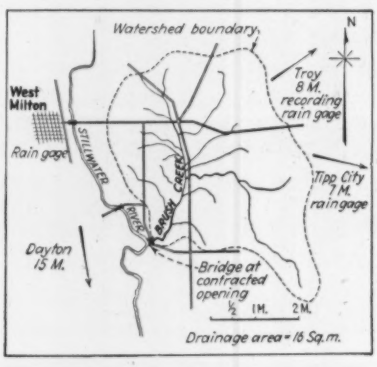


Fig. 1. Map showing the Brush Creek watershed, where studies were made.

Fig. 2. Damage to embankment around abutment of bridge at outlet of Brush Creek watershed.

The resulting rise in Brush Creek developed sufficient head against the road embankment at the bridge across the lower end of the creek to wash out a portion of the fill adjoining the bridge, as is shown in Fig. 2. Well defined high-water marks were secured several days after the freshet both above and below the bridge. These indicate that the drop-off through the opening was 5.55 ft.

Calculations of the peak flow were made by the contracted opening method. The area of the contracted section measured 762 sq. ft., before it was enlarged by the scouring action of the flood flow. Immediately upstream from the bridge the flood channel has an area of 4,530 sq.ft., from which it was determined that the velocity of approach was about 3 ft. per sec. A contraction and velocity co-efficient of 0.95 was used for the computation of maximum discharge. From these data it appears that the peak flow was 13,500 cfs, or 845 cfs per sq. mi. This is probably a minimum figure, as the area of the contracted opening may have been enlarged considerably before peak flow occurred. After the freshet the area of opening was 2,420 sq.ft.

FIG. I. GRIT CHAMBERS AND SCREEN HOUSE OF THE JOINT MEETING PLANT IN ELIZABETH, N. J.

Unusual Sewage Plant Operation

Contents in Brief—Two years' operation of the Joint Meeting disposal plant serving twelve communities in northern New Jersey, has furnished new information on pumping concentrated sludge through a long pipeline and has provided data on experiences with a Mieder travelling-bridge sludge collector. Also given are the operating problems, plant performance and treatment costs at New Jersey's second largest disposal works.

OPERATING EXPERIENCES of unusual interest distinguish the two-year record of the disposal works of the Joint Meeting at Elizabeth, N. J. (The Joint Meeting is an agency representing 12 communities in Essex and Union counties.) The Elizabeth plant, the second largest in New Jersey, has several unique features, the principal one being the method of handling raw sludge through a decantation process and subsequent pumping of the thickened material through a 24-in. cast-iron pipeline for a distance of 4,400 ft. The operations of a Mieder travelling-bridge type sludge collecting mechanism in the settling tank likewise commands attention because this installation is the only one of its kind in North America; its introduction to this country was based on successful performance at several plants abroad under conditions similar to those encountered at Elizabeth.

The plant was put in operation in March, 1937. It is on the outfall line from a trunk sewer system over 43 mi. in length, built some years ago, that discharges into Arthur Kill, part of the New York harbor waters.

The plant provides primary treatment and is equipped with grit-removal and screening equipment in addition to sedimentation facilities. It is designed to handle an ultimate flow of 172.5 mgd, excepting for the installed sedimentation capacity which is sufficient for only 100 mgd on a two-hour detention period basis. Present flow averages 28 mgd from a contributing population of 300,000; therefore only one-half of the plant is in active use. Sludge from the sedimentation tanks is stored in concentration tanks prior to its removal by barge for ultimate disposal at sea. At the present time an average of 500 tons of sludge per month is being dewatered by centrifugal machines at a demonstration installation operated by the American Centrifugal Corp. (*ENR*, Sept. 14, p. 347).

A flow diagram and illustrations of the plant layout are shown in Fig. 3.

The sludge problem

Concerning experiences with sludge handling, Leslie E. West, chief engineer of the Joint Meeting, states that the pumping of some 73,000 gal. of sludge daily into storage tanks is accomplished without difficulty but that the pumping of concentrated material into barges has been beset with problems.

It was originally intended to thicken fresh sludge with the aid of chemicals but this was found unnecessary because a natural thickening action occurred in storage. Concentration and decantation of the separated liquor reduces the moisture content from an average of 94.5 to about 92 per cent. Consequently, the "thickener" tank is not operated as such but serves rather as a receiving tank

Fig. 2. Sludge scraper of the travelling-bridge type, the only one of its kind in this country. Note the perforated influent baffle on the far end of the settling tank.

for fresh sludge, and also affords a place where scum ejected from the settling tanks can be mixed with the sludge. From the thickener tank the sludge is pumped to either one of the two storage tanks or can be delivered directly to the centrifugal pump building.

Sludge is kept in storage until sufficient volume is present to fill a 3,500-ton barge. The storage tanks are of concrete construction, 70 ft. in diameter, with an effective depth of 23.8 ft. and having a total capacity of 626,000 gal. or 2,730 tons. As an odor control measure, each tank is equipped with a floating cover which rests on the surface of the sludge. The tanks are unheated and little digestion takes place, except when the sludge temperature rises to 70 deg. F. in late summer.

When freshly collected sludge from this plant is allowed to stand for any length of time, a natural separation of water from the solids takes place. When the sludge is acid and at a temperature of 55-60 deg. F., the stratification of water occurs at or near the bottom of the mass; in an alkaline sludge of any temperature or an acid sludge of 50 deg. F., or lower, the tendency of stratification is toward the top. By providing suitable taps for removing the segregated liquor at the elevation where it occurs, a reduction of the original volume of 25 to 40 per cent may be accomplished. Decanted liquor which is returned to the incoming sewage has had no noticeable ill effects on plant operation.

Centrifugal pumps for sludge

The removal of stored sludge from the concentration tanks to the barge has been a challenging problem, according to Mr. West. An explanation of the difficulties in pumping this material is being sought in a study of the physical characteristics of the sludge. The situation can be summed up as follows:

Raw sludge as removed from the settling tanks is quite uniform in consistency regardless of the amount of solids present, and its fluid characteristics in relation to similar heavy liquids are such that gravity flow through adequate size pipes is possible. Experience at the Joint Meeting plant has been such as to lead to the conclusion that freshly collected sludge of any moisture content down to about 93 per cent can readily be handled in large volumes by suitable centrifugal pumps.

When sludge is placed into storage and the mass remains quiescent for a number of hours, a separation of sludge and water occurs. Following this stratification, the water so separated does not again mix readily with the sludge unless the material is vigorously agitated. By careful control, therefore, excess water can be drawn off by decantation.

The concentrated sludge thereupon acquires a jellylike character or set and resists efforts to cause it to flow by gravity in pipes. And when an endeavor is made to remove the material with centrifugal pumps, difficulty from cavitation occurs, and very low pumping rates result. Even if the stratified water originally present is allowed to remain in the tank, the situation is not improved; what happens then is that the water is quickly pumped off, leaving the heavy sludge unmoved. The only way in

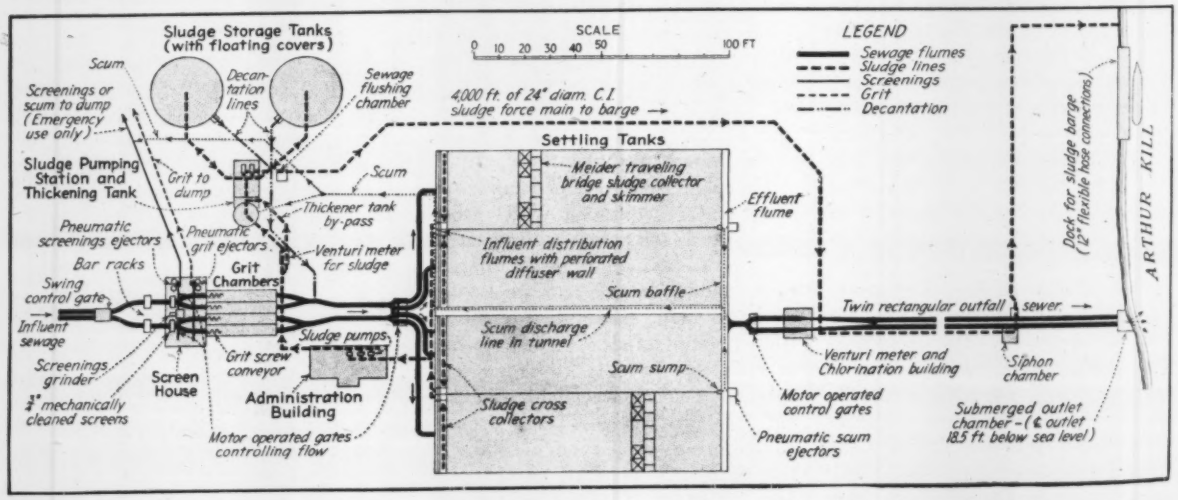


Fig. 3. Flow diagram and layout of the disposal works. Sludge is concentrated in storage tanks and then pumped more than 4,000 ft. to a barge for final disposal far out at sea.

which a sludge of 92 per cent moisture content can be pumped to the barges efficiently using centrifugal pumps is to break up the gelatinous mass, using a water jet operating under 50-lb. pressure.

A second important characteristic affecting pumping has to do with the viscosity of the sludge in relation to temperature. During the last two years the range in temperature of the sludge has varied from 48 to 74 deg. F., and the time required to pump 3,500 tons has varied accordingly from 12 to 4 hr. It has been noted that when 70 deg. F. temperature prevails, high rates of pumping are obtained with total heads of around 12 ft.; at 50 deg. F., however, a pressure head of over 40 ft. is registered and the pumping proceeds with difficulty. Frequent interruptions occur during which the pipeline to the barge is blown out with compressed air at pressures as high as 30 lb. per sq.in.

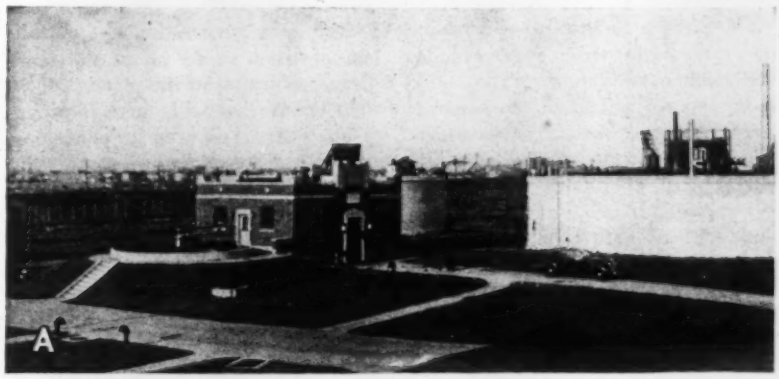
The original pumps for loading sludge were two 8-in. centrifugals, each having a capacity of 2,000 gpm at 23-ft. head. Alteration shortly to be completed will provide one 8-in. centrifugal rated at 2,000 gpm at 40-ft. head and one 10-in. centrifugal rated at 3,000 gpm at 37-ft. head.

Despite the handicaps in loading and the introduction of a certain amount of additional water used in sludge agitation, the cost of disposal of sludge is only 30.5 cents a ton, much less than is possible by any other known method adapted to the Joint Meeting disposal works, says Mr. West.

Settling tank operation

The sewage flow generally is divided between two of the four settling tanks available, where it is subjected to a detention period of about 3¼ hours. The tanks are 280 ft. long, 75 ft. wide, and have an average depth of 13 ft. Adjustable effluent weirs between elevations of 3.0 and 6.4 provide additional tank capacity for increasing the calculated detention time. Each tank is equipped with perforated inlet baffles for flow distribution, and scum baffles are located in front of the effluent weirs.

Two Mieder travelling-bridge sludge collectors, specially built for this plant by the Link-Belt Co., are employed to scrape the bottom of the tank and also to skim the liquid surface for scum removal. The Mieder collectors are machines of the tractor-crane type having a clear span of 75 ft. When moving in a forward direction the scraper blades can be easily adjusted to the surface elevation of the tank liquid and the scum is skimmed from the surface and concentrated in the narrow space between the blades and the top baffle at the effluent end of the tank. On the return trip the blade is lowered to the bottom of the tank where it sweeps the settled sludge to cross-collectors at the influent end.



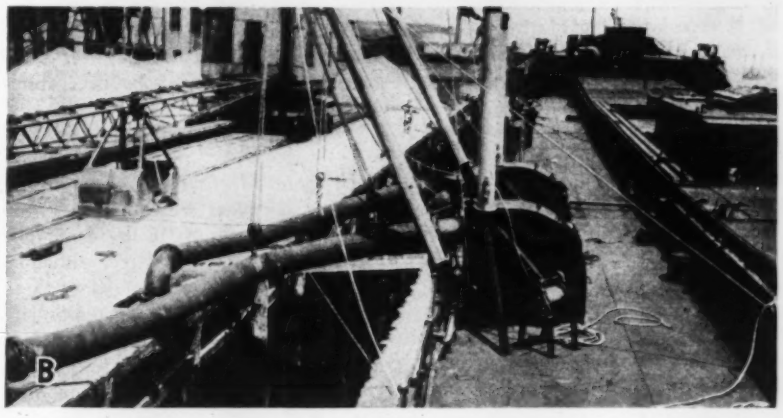


Fig. 4. How sludge is handled: (A) thickener tank, pumping station and concentration tank; (B) flexible hose connections between the 24-in. sludge main and barge; and (C) discharging sludge at sea from outlet valves near the stern of the barge.

For skimming operations the velocity of travel of the collector is between 5 and 10 ft. per min.; for sludge collection the blade is moved at 2 to 3 ft. a minute. A cruising speed up to 75 ft. per min., however, is possible. This cruising speed is used when the machine is transferred from one tank to another, an operation which can be performed by means of crossrails at both ends of the tanks. Two machines have been installed at this plant and either one

of them can be used in each tank.

The scraper is formed of ½ x 6-in. gum rubber attached to a metal blade. The rubber pad rests on the tank floor, and the weight of the blade is carried by steel wearing shoes which ride on steel rails embedded flush with the tank floor. This arrangement permits smooth action of the scraping blade with no noticeable agitation of sludge.

Sludge from the tanks is removed once every 24 hours, the pumping period lasting about 5 hr. About five complete trips of the scraper are sufficient to remove all of the sludge. Removal of solids from the raw sewage which has a suspended solids content of about 184 ppm averages better than 66 per cent.

Grinder for screenings

The handling of screenings during the first year of plant operation was difficult and unsatisfactory. Material removed from the fine screens was transported by belts to pneumatic ejectors from which it was discharged through a pipeline onto adjoining meadowland. It was impractical to bury the screenings because the surface of the ground was under water at high tide twice a day, and it was not possible to cover the material since fill was unavailable and no access roadways were built across the meadow. Nuisances from odors, flies and rats, and the unpleasant working conditions occasioned by the necessity for altering the position of the discharge piping called for a change in method. This led to the installation of a screenings grinder.

The arrangement as finally developed consisted in the utilization of the pneumatic ejector for the discharge of material into an overhead storage hopper placed above and connected with the grinding machine. The screenings are fed to the grinder manually and the finely macerated material is returned to the incoming sewage. Experience with this scheme has resulted in the incorporation of several refinements further to improve the process. These include the addition of a full inclosure of the screening tray, arrangements for better control of screenings during feeding, wash water and spray lines in the storage hopper, lighting for improved night operation, and the installation of a fume hood with ventilating ducts to the outside of the building for odor control. This method of handling screenings, has proved to be the solution of the problem of what to do about the most disagreeable job in the plant.

In connection with these improvements, a steel belt used for conveying material from the screens to the ejectors has been replaced with one made of monel metal. This has eliminated a rusting and corrosion problem that interfered with the efficiency of conveying wet and oftentimes corrosive materials; the monel metal belt, incidentally, was cheaper in price than the steel belt because it could be made of thinner metal. The belt is 15 in. wide, 130 ft. in length, has a thickness of 0.032 in. It was fabricated for this job by the International Nickel Co.

The Joint Meeting

The Joint Meeting had its origin as far back as 1900 when it was foreseen by communities in the drainage areas of the Elizabeth River and the east branch of the Rahway River that the limitations of flow in these small watercourses made imposible the individual solution of the sewage disposal problem in adjacent municipalities. After many conferences, seven municipalities entered into the formation of the original Joint Meeting and constructed a trunk-line sewer to tidewater with dilution as the method of disposal. The capital cost of this sewer was paid for on the basis of the percentage of the capacity reserved by each municipality, taking into account the mileage of sewer used; maintenance charges were paid for on the basis of an annual assessment divided equally between the contracting municipalities.

For 20 years this arrangement worked splendidly until the abnormal and entirely unexpected growth of population of the area served caused overtaxing of the sewerage facilities and necessary enlargement. About 1922 plans were laid for the construction of a supplementary sewer and sewage treatment plant. Actual construction of the enlarged collecting system was begun in 1926 and completed in 1932. The treatment plant was started in 1931 and finished in 1937. The six years' time expended on plant construction involved a three years' delay because of financial difficulties. Completion of the work was accomplished with the assistance of the Public Works Administration.

Alexander Potter of New York City has been consulting engineer for the Joint Meeting since its establishment almost forty years ago, and the sewers and treatment plant were designed and built under his direction. Peter A. Smith of South Orange is chairman of the Joint Meeting.

Leslie E. West is chief engineer with supervision over plant operation and sewer maintenance. Willem Rudolfs is sanitary consultant.

PLANT AND OPERATION DATA

Sewage Flow (average):

Daily	26.28 mgd
Max.	40
Min.	18

Coarse Racks (3-in. spaces)—17 cu.ft. per day or 0.66 cu.ft. of debris per mg.

Fine Screens (¾-in. spaces)—95 cu.ft. per day or 3.73 cu.ft. per mg. The grinder has a capacity of 40 cu.ft. per hr.

Grit Chambers—172 cu.ft. per day or 6.54 cu.ft. per mg.

Sedimentation (four tanks are available, each 75 x 280 x 13 ft. deep):

Sus. Solids—

Influent	184 ppm	(1,532 lb./mg)
Effluent	61 ppm	(508 lb./mg)
Removal	66.8 per cent	(1,024 lb./mg)
Cost per lb. removal		$0.008

B.O.D.—

Influent	202 ppm	(1,682 lb./mg)
Effluent	122 ppm	(1,016 lb./mg)
Removal	39.2 per cent	(666 lb./mg)
Cost per lb. removal		$0.013

Sludge—72,608 gal./day; 94.52 aver. moisture content

Scum—1.0 cu.ft./mg

Sludge Storage (two circular tanks, 70 ft. diameter 23.8 ft. deep; cap. 626,000 gal.)
Daily pumpage—72,608 gal.
Concentration—30,150 gal. of liquor decanted daily; volume reduction 41.5 per cent.

Sludge Disposal—Twice monthly by barging to sea. Daily accumulation in storage averages 185 tons; moisture content 92.22 per cent.

Operating Costs:
Total $80,356 (this includes an item of $20,604 for sludge barging)
Cost per mg $8.38 (in 1937 this figure was $10.97)
Cost per capita $0.268

Personnel—Plant personnel, in addition to the chief engineer who supervises both plant operation and sewer maintenance, includes 20 men as follows: 1 clerk, 1 electrician, 1 mechanic, 1 chemist, 1 sludge station operator, 8 regular and 3 relief operators, and 4 laborers.

Population Served—300,000; the designed capacity will accommodate about 1,000,000 population load.

Area Served—Twelve municipalities in Essex and Union Counties, N. J. Included are Hillside, Irvington, Maplewood, Millburn, South Orange, Summit, Union, West Orange, and parts of Roselle Park, Newark, East Orange and Elizabeth.

Clay Augers Sink Foundation Wells

Contents in Brief—Boring machine sinks 200 shafts through 70 to 80 ft. of clay and boulders to bed rock for Montgomery Ward & Co. building in Chicago. Designed process contemplates boring and concreting in water but the city building code requires lined shafts, pumping and concreting in open air. Both the designed process and the present method described in detail.

SOME 200 foundation wells are being sunk by large boring machines in one of the most recent large building operations in Chicago. Filled with concrete, these wells, which go through 70 to 80 ft. of clay, running sand and boulders to bedrock, will support the columns for a new addition to the buildings of Montgomery Ward & Co., bordering the North Branch of the Chicago River. The boring method is new both in the form of bit or cutting tool and in the fact that the boring is done in a water-filled hole the overflow from which carries away the excavated material. Also, the method includes concreting the well by tremie, the concrete, as it fills the hole, pushing up the water-clay slurry; but so far in the work, except for one test well, the Chicago building code authorities have not approved the tremie process but have required the hole to be bored, pumped out and concreted dry. By either method, however, the operation is unique in recent foundation work.

What the job is

The Montgomery Ward & Co. buildings, as shown by Fig. 2, occupy an area along the river and the North Branch Canal and are built close to the bulkhead line. As indicated by Fig. 2 the present development includes several operations; one of the largest, besides the new building foundations, is moving the display factory several hundred feet north to clear the site for the new building. The moving operation is about completed and foundation sinking is in full swing in the cleared area. To date, some fifty piers have been completed.

Fig. 3 indicates the foundation arrangement. In all cases except where cantilever beams are introduced along existing walls of the adjoining buildings, the building columns rise directly from enlarged tops of the concrete piers to rock. These are 4 ft. in diameter for the heavier and 3½ ft. in diameter for the lighter loads, and the bored wells in which they are built are 5 in. larger. Column loads vary from about 375 to 750 tons and there are 23 4-ft., and 177 3½-ft. piers. The column spacing is 20x17½ ft. For about 5 ft. at the top, the piers are enlarged to a diameter of 5 ft. and dowels and spirals are set in the tops to connect with the building columns.

The ground conditions at the site are those common to Chicago: dense clay 70 to 80 ft. deep overlies bedrock and just above the rock a stratum of gravel and boulders. The wells and concrete are carried to clean bedrock. This is the regular

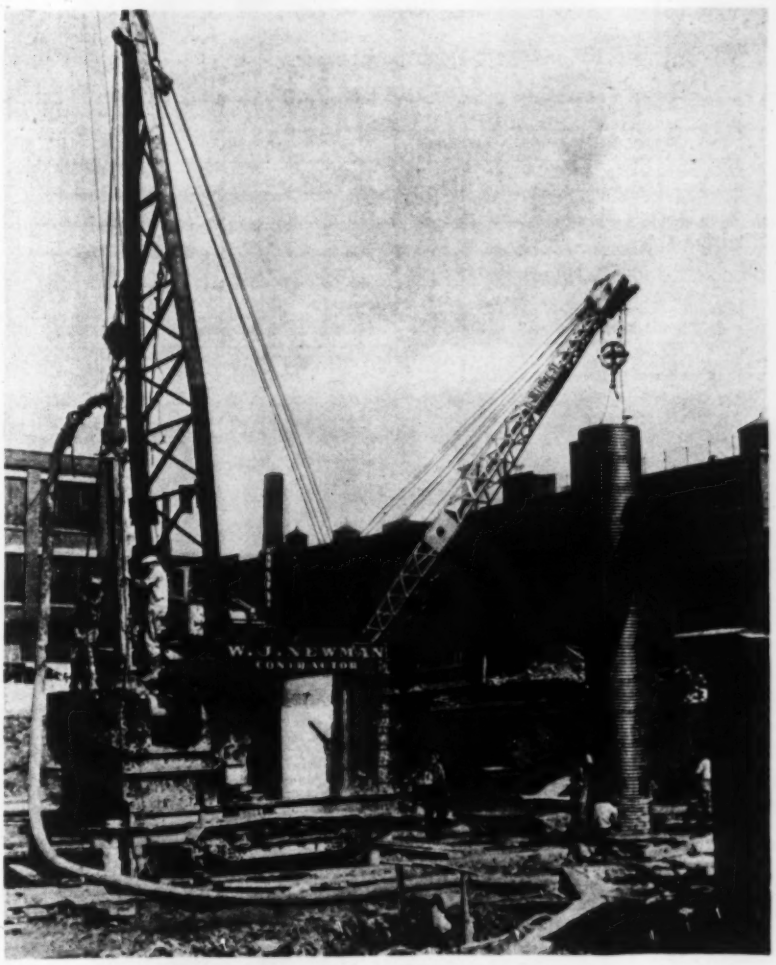


Fig. 1. Boring 200 shafts 70 to 80 ft. to rock to build 3½ and 4-ft. concrete piers for the Montgomery Ward & Co. building in Chicago; derrick at the right is placing the lining in a shaft previously bored.

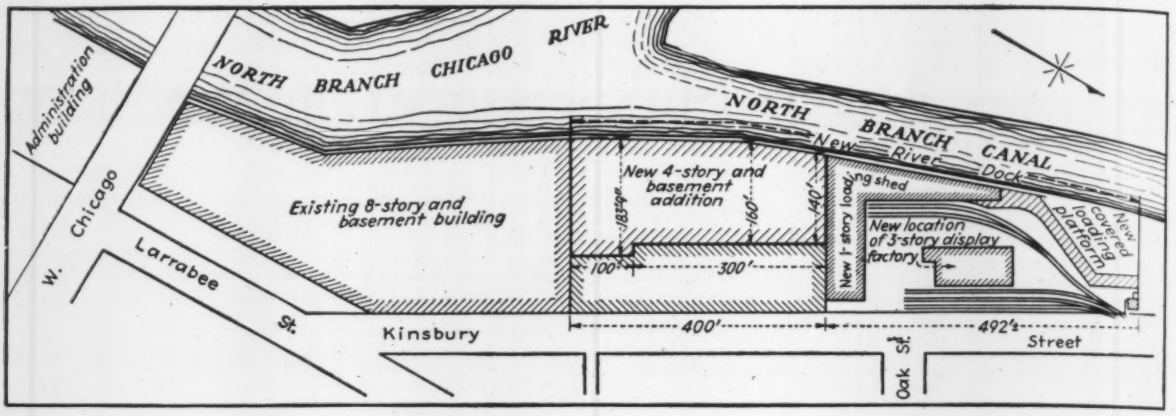


Fig. 2. River-bank buildings of Montgomery Ward & Co., showing the location of the new construction in progress.

"Chicago type" foundation, until now almost always constructed by hand digging and curbing of the walls as the well was deepened. Concrete was then placed in a dry hole. The present operation is the first in which any other procedure has been followed except in a tentative way, and here as said before, the new process is not being used entirely as designed because of objections by the city building code authorities.

Revolutionary as designed

The new process has little resemblance to the old. In the old process every effort is made to exclude water and dig a dry well, line it and place the concrete in air. The new process introduces water as a major aid. The boring machine operates in water—not merely in a wet hole, but one filled with water and constantly overflowing. Again, the water holds the sides of the hole and no lining is intended. And finally, the hole is concreted by tremie in water. In the Montgomery Ward & Co. work only one foundation was completed as described; the others up to the present are being required by the code authorities to be built by a modified method described later.

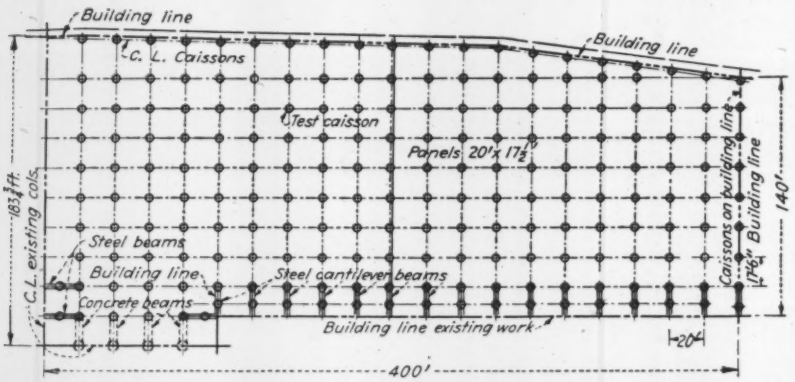


Fig. 3. Column piers for new Montgomery Ward & Co. building; 200 piers built in shafts bored to rock through 70 to 80 ft. of clay overburden. Note the cantilever supports for wall columns.

The trial foundation located as shown by Fig. 3 called for a 3½-ft. concrete shaft. To start the boring a 5-ft. hole about 10 ft. deep was dug by hand and lined with a steel shell. A drill rig similar to that shown by Fig. 1 was centered over the steel shell; it consisted of a 12-in. hollow pipe shaft passing down through the

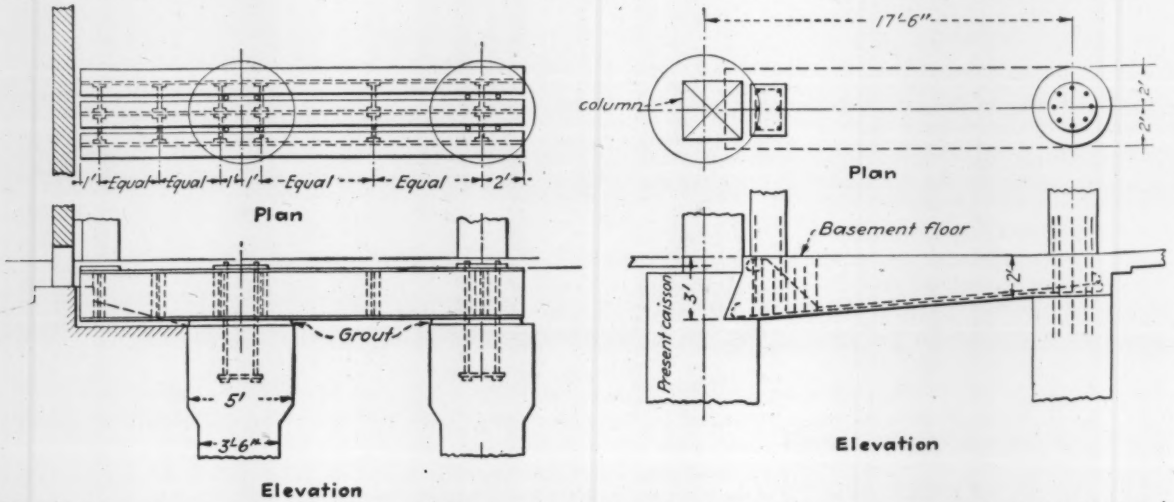


Fig. 4. Wall columns next to the existing buildings are carried on two types of beam supports springing from the piers of the new building.

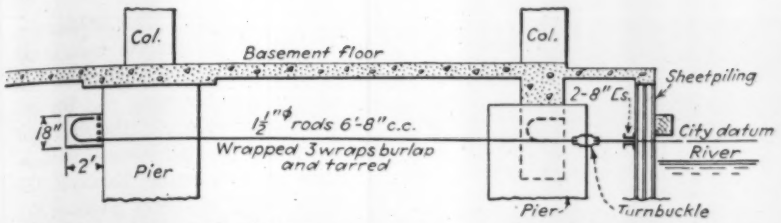


Fig. 5. The dock wall on the river front of the new building takes its support from piers carrying the building columns.

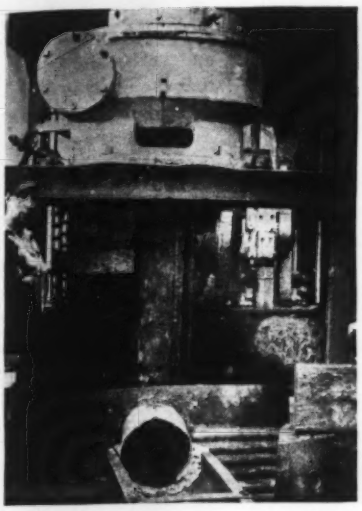


Fig. 6. Operating head of shaft boring machine. The turning mechanism engages full-length keys on the 12-in. hollow shaft. These keys permit the shaft to slide down through the operating head as the hole deepens.

operating head, Fig. 6, and carrying at its end a bit or cutter head shown by Fig. 7. The cutter head operated in water pumped to a swivel head at the top of the shaft as indicated by Fig. 1. Enough water was discharged at the bit end to emulsify the clay as it was ground away by the cutters and to keep a constant overflow of slurry from the 5x5-ft. shell into drains. The slurry was kept thin, not as heavy even as a thin cream. The hole bottomed on rock at a depth of 84 ft. A suction bailer removed any stones and lumps of clay at the bottom of the hole.

Concreting was not begun until 10 days after the shaft was bored; this is not intended practice. It is intended that concreting shall begin as soon as the bottom of the hole is cleaned and shall be continuous until the shaft is filled. Because of the 10 days' delay the sides of the hole had sloughed some but not considerably. Concrete was placed by tremie always keeping the outlet well buried. Examination showed the concrete in good contact with the rock and cores taken in 28 days showed strengths from 3,600 to 4,440 lb. Inspection was made from a lined shaft bored close alongside the trial pier.

Actual procedure followed

The building code required the shafts to be lined and the concrete to be placed in the air. As the work is being done the drilling process is in general about the same as for the test foundation. Three drill rigs are now in operation and as experience is gained faster work is being done. Recent shafts have been put down in 13 hr. drilling time and 17 hr. elapsed time. Constantly closer scheduling of the successive operations is the reason. Also, more is being learned of the technique of operation. For example, it has been learned that the cutting speed of the drill bit is influenced by the density of the slurry. There is an optimum condition of the slurry for the fastest drilling; a thinner or thicker mixture of water and clay reduces the cutting speed. Because of this and because the clay also has different characters at different depths and in different holes skill of drill operators assumes great importance.

Fig. 7. A cutter head bolted to the end of a hollow shaft acts to grind out the clay in fine enough particles to emulsify in the heavy stream of water coming down the hollow shaft and forcibly jetting out of the holes just above the cutters.

After drilling and while the hole is still filled with slurry the assembled lining tube is lowered into the hole and brought to as near the bottom as possible. The lining tube is the exact diameter of the concrete pier to be built but the hole is drilled 5 in. larger so that the lining slips

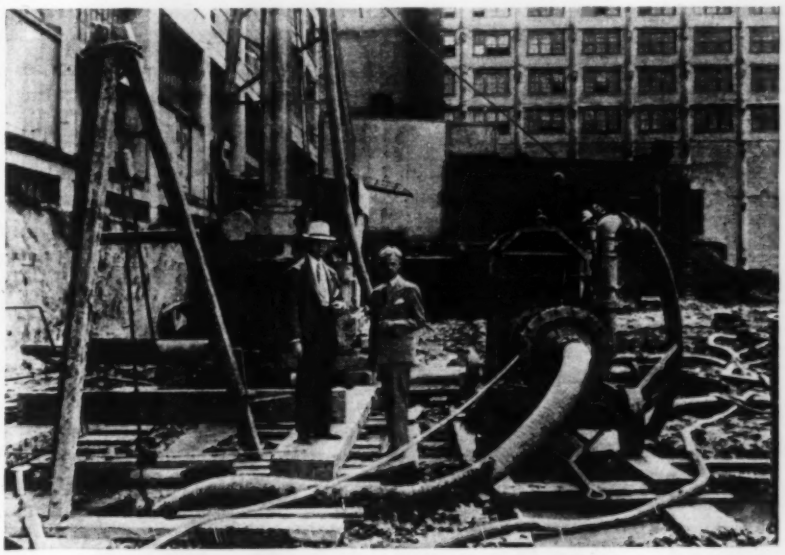


Fig. 8. Close sequence of operations is important in getting speed; the boring machine sinks a new shaft as the preceding shaft is pumped out after the lining has been placed as shown by Fig. 1.

down generally without much trouble. Then the bottom of the hole is given a first cleaning with a suction bailer. The next step is to seal the bottom of the lining so that the shaft can be pumped out. Sand is filled into the annular space between lining and the shaft wall to a level well above the bottom of the lining. Dry sand-cement grout mixture is then blown in to seal the lining and the water is pumped out. The shaft bottom is cleaned and the pier is concreted.

The indicated advantages of the process are speed, reduced cost and less hazard to life. Even with the handicap of lining and laying dry the wells, the present work is demonstrating increased speed. Except for the final cleaning of the bottom no one need go into the shaft; and the process as designed calls for no underground work.

At the Montgomery Ward & Co. building Edwin W. Byers is engineer in charge for the owners, with Frank A. Randall as consulting engineer. The process has been developed by W. J. Newman, veteran Chicago foundation contractor.

Underground Water in Court

Contents in Brief — Pasadena, Calif., has filed suit to clear up the question of rights to waters in an underground basin from which that city and others have been extracting water faster than it has been replaced. Court action now awaits report from the state division of water resources acting as referee on investigational work in conjunction with 28 litigants.

FOR THE FIRST TIME the courts have been asked to make a general adjudication of rights to underground water in an entire basin in Southern California, and there is prospect that legal precedents may be established when the case is settled. Action was begun as a "friendly" suit in an endeavor, first, to have the rights and claims of the several users of water from Raymond Basin determined, and second, to determine the safe yield of the basin. Since the action is in the nature of petition for injunction and degree to quiet title, some of the correspondents saw nothing "friendly" in the action and filed demurrers.

The complexity of the questions involved was such that after some preliminary hearings the court (superior court for the county of Los Angeles) appointed the Division of Water Resources of California as referee "to investigate all the physical facts involved" and "report to the court thereon." From present indications it will be more than a year before the investigations can be completed and the report ready for further court procedure.

Raymond Basin, which underlies most of Pasadena, extends generally southward from the foothills; from Arroyo Seco to Raymond Hills and northeasterly to Santa Anita Canyon. Out of this basin Pasadena, South Pasadena, Monrovia, Alhambra and Sierra Madre pump for domestic use, and while most of the remainder of the area is of an urban character (although unincorporated) there is some use for irrigation. Altogether, 17 water companies or municipalities and 33 individuals draw upon this basin. The claim that Raymond Basin is a separate and distinct underground basin, and that its boundary is marked by a fault or dike running entirely across the valley from mountain to mountain, is supported by the fact that although the location of the fault is only vaguely apparent on the surface, the water table is about 300 ft. higher on the upstream side of the fault than on the lower side.

Those who draw water from this basin are in two general classes: (1) appropriators, including all water companies and municipalities either overlying the basin or exporting from it and (2) those in whom a right is vested by virtue of use on land overlying the basin. Not all in this latter class have been brought into the suit: it was thought sufficient to bring in only the companies, municipalities and a few of the largest individual users. Involved in legal adjudication are questions concerning (1) the recharge of the basin (2) the draft on the basin and (3) the interconnection or lack of connection between the groundwater of different parts of the basin, and as a corollary of this, the source of recharge of each section of the basin.

Pasadena, in its complaint, alleges that the total average annual recharge of this underground basin is 23,500 acre-ft., that the draft is about 50 per cent greater than this and that Pasadena has paramount right to 14,600 acre-ft. from the basin. Pasadena asks that the draft by others be decreased so that total extractions will not exceed total annual recharge.

The suit also seeks to have those overlying landowners who are not using water enjoined from any such use. Complexity of the situation is increased by the fact that there is no statutory law in California on underground water rights but the common law doctrine is followed which gives to each overlying landowner the right to use an equitable share of the water beneath his land.

In its order of reference to the Division of Water Resources as referee, the court suggested that the different parties to the suit, either singly or in groups, appoint engineers to represent them in the proposed investigational work to be directed by the referee. This group of engineers is now functioning as a consulting board in the investigation.

Court instructions to the referee specify that the report shall cover four phases of the subject, namely:

(1) All factual data about (a) the quantity of water developed in the basin from underground sources, (b) diversions from surface water that contribute to the underground supply, (c) chemical character of the water and (d) uses within, or exportations from the basin.

(2) A complete geological report on the region so far as it has a bearing on the underground water problem.

(3) The correlation of all data gathered in 1 and 2, and

(4) Conclusions as to (a) the safe yield of each basin or sub-basin within the area involved, (b) the surplus water available, if any, and (c) the overdraught on part, or all of the area, if overdraught is found.

BUSINESS
Stands Against War

Let us take a clear-eyed look at this thing we call War.

WAR is a political tool for domination or suppression; a device of futility—unless it be waged in defense of our homes, our property or our rights—in the preservation of our liberty. War destroys everything it touches. So completely does it disrupt the order and progress of civilization that humanity falters.

Dangerously widespread amongst our people today is the assumption that our participation in the European War is inevitable. Some mistrust the temper and program of the federal government as likely to lead us into it; others fear that our sympathies will make us an easy prey to the propagandists; still others suspect that business and industry, in a blind greed for profits, may involve us in the conflict.

To give credence to such beliefs is to deny that we are normal individuals, endowed with intelligence and a will, or the ability, as a people, to profit by our own experience. In all human experience, death only is inevitable.

To say that Industry and Business want war or will encourage, directly or indirectly, our participation in the present war, is a vicious and deliberate lie.

The millions of us who, since the World War twenty-five years ago, have devoted all our efforts and energies to creating and building and improving that which we know today as American Industry and Business, are convinced that the destiny of this country can be wrought only in peace. We cannot, and *must* not, stand aside and watch even the little progress we have made since that war sacrificed to the pestilence of another world conflict. We who are trying to build a lasting heritage for those who will follow us truly know that "there never was a good war or a bad peace".

Perhaps it is time to re-emphasize two of the three elements of our democratic faith, so simply stated by Abraham Lincoln, "that government of the people, by the people, for the people, shall not perish from the earth". Now, of all times, it will be wise to inform our political stewards that government by the people and for the people must be the guiding principle in what they do during the days to come, and that it is our *will* that in our country peace shall be preserved.

Only the grim and solitary courage of each of us, the determination to exert all our intelligence, all our individual influence in every way, can insure the preservation of peace for our country.

Preparedness we know to be the most effective preventive weapon against the threat of war. We must be certain, therefore, that we provide our air, land and sea forces with the best in armaments and material, in adequate supply to maintain properly and impressively our national responsibilities and defense.

Most important is that we as individuals, thus inspired, band together to exert the full strength of Industry and Business in the maintenance of peace.

If we are to succeed, we must be forceful, we must be articulate. To that purpose we pledge ourselves and the resources of our publications. An expression from our readers will greatly assist in such a mobilization of industrial opinion. Together, in this critical time, we can serve America well!

James H. McGraw, Jr.

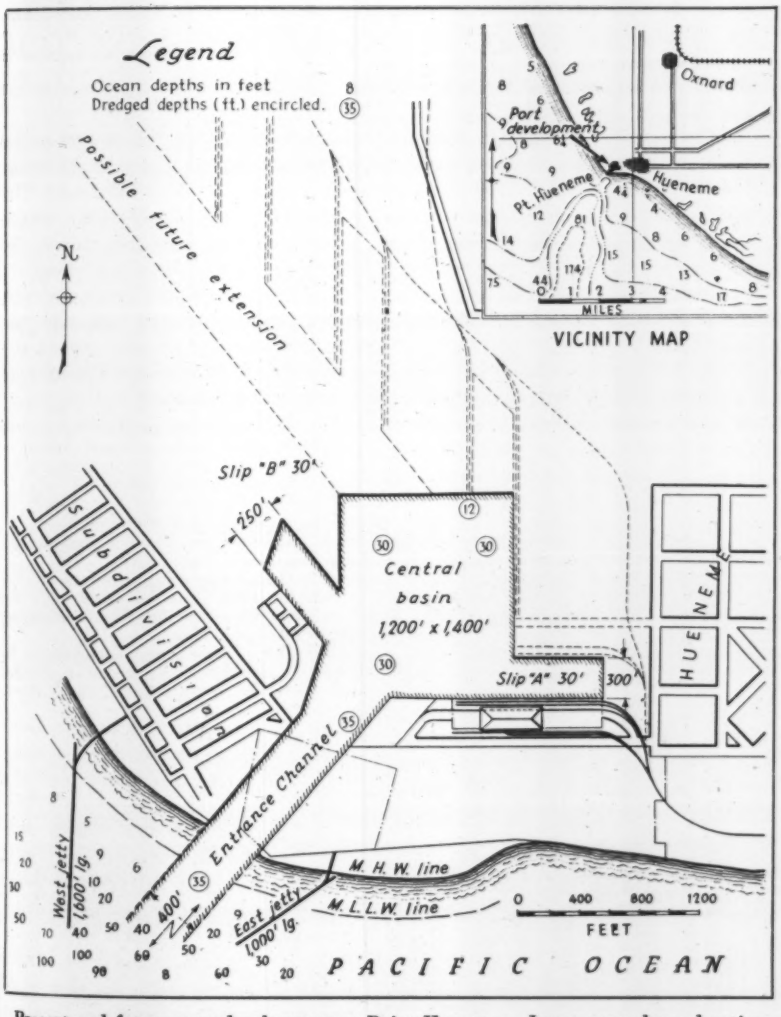
President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

Built-To-Order Harbor Begun at Inshore End

***Contents in Brief** — Construction of an artificial harbor to serve an expanding farming and industrial district on the Pacific Coast is being done largely from the land side to minimize effect of storms on dredging work.*

THE OXNARD HARBOR DISTRICT, comprising the southern part of Ventura County, Calif., centering about Point Hueneme, some 40 mi. southeast of Santa Barbara, recently voted $1,750,000 in bonds and without financial aid from state or federal government is proceeding to develop a port through which local products, now largely agricultural and mineral, can be shipped to market, and raw materials and manufactured articles imported. The bond issue carried by an 11 to 1 majority, indicating the spirit behind an enterprise for reviving, on a modern scale, port operation that flourished long ago at this location. In the early seventies a 1,600-ft. wharf at Point Hueneme was the second largest grain shipping point in California.



Present and future port development at Point Hueneme. Insert map shows location of the submarine gorge, also ocean depths.

The port development now under way is based on two factors believed to be essential to economic soundness of such a venture: (1) a water gateway at this point will serve a very rich and productive hinterland susceptible of development along both agricultural and industrial lines to an extent that would justify development of port facilities and (2) the location has natural advantages for port development. The Indian name Hueneme, which signifies "quiet waters," is believed to have been applied because (1) the Channel Islands protect this portion of the coast from prevailing winds and (2) a deep submarine valley, (presumably a prehistoric river channel) brings ocean depths of 30 ft. to within 400 ft. of the low-water line. The new port development is being constructed at the head of this submarine valley.

The present project naturally divides itself into three units: the construction of two protective breakwaters, or jetties; excavation of an access channel, a central basin and slips, and finally the construction of wharves, warehouses and other port facilities. As a whole, the present undertaking is a first step; extensive future additions are provided for.

The two jetties, 1,600 and 1,000 ft. long, respectively, converge as they extend seaward, leaving an entrance width of 1,100 ft. between their outer ends. Jetty construction is well along, using a dense andesite rock brought about 60 mi. on barges from Catalina Island quarries. The lower core rock is dumped in place; armoring and top stone, ranging up to 15 tons, and the upper core rock are placed with a floating derrick. Total rock to be used in the jetties is to be about 115,000 tons.

The dredging includes the excavation of 4,250,000 cu.yd. to form a 2,000-ft. access channel with a 400-ft. bottom width and a depth of 35 ft., and an inner harbor excavated in the low, flat land bordering the shore. The inner harbor includes a 1,200 x 1,400-ft. central basin with radiating slips and channels of 30-ft. depth.

In contrast with the usual method of starting a dredging contract from the deep-water end and working toward the shallows, this job was started on the land end. A small, portable suction dredge was moved

overland to the site and launched in a small basin previously excavated by a dragline some 1,200 ft. inland from the shoreline. From this basin the small dredge is cutting a pilot channel seaward through the beach between the jetties. As soon as this channel has sufficient depth at high tide, a 24-in. suction dredge will be moved in from the ocean to the sheltered inshore basin where it will be able to work regardless of weather and the offshore swells.

The entire inner harbor included in the present contract is to be excavated before the entrance channel is completed. However, a communicating channel will be maintained to admit supply boats and narrow channels will be dredged along each side to facilitate early placing of slope revetment.

Wharves, transit sheds, rail and highway connections are to be covered in separate contracts which will be let at a later date.

The general contract is held by the Standard Dredging Corp., with completion date set for July 20, 1940. Rock placement has been sublet to the Rohl-Connolly Co. Engineering work on the project has been done by the firm of Quinton, Code and Hill-Leeds and Barnard. Construction is under the joint direction of Chas. T. Leeds and A. F. Barnard, for whom F. S. Harvey is resident engineer in charge of work on the harbor project.

A Soil Shear Dynamometer

C. R. YOUNG

Professor of Civil Engineering, University of Toronto, Toronto, Canada

A SATISFACTORY DEVICE for determining the shearing force in soil shear tests, alternative to that described by Harold A. Fidler in *Engineering News-Record*, June 8, 1939, has been found in the soil mechanics laboratory of the University of Toronto to be the comparatively simple spring dynamometer shown by Figs. 1 and 2.

As is evident from Fig. 2, the device consists primarily of two telescoping cylindrical drums enclosing a coil spring. The base of the outer drum has a machined boss on the inside with a diameter about equal to that of the inner diameter of the spring to act as a guide. The open end of the outer drum is bevelled on the outside and at one point on this bevel a plane surface is milled to permit a celluloid window to be attached, with a scratch for reading the scale on the inner drum.

A boss similar to that provided on the base is turned on the inside of the upper closed end of the inner drum for centering the spring. Inserted through the center of this boss is a loading tube, made as long as possible to give a leverage for guiding the compression of the spring. Near the top of the inner drum a small breather hole is drilled to prevent the cushioning of air as the drums telescope.

The loading cap consists of a steel cup with fixing screws to fit the ram of a hydraulic jack or the circular bearing disk used for soil shearing tests, and a $\frac{3}{8}$-in.-diameter drill rod loading tongue. In this way all load is applied through the tongue at the bottom of the loading tube and binding of the drums is obviated. The clearance around the loading tongue permits a substantial variation in the direction of application of load.

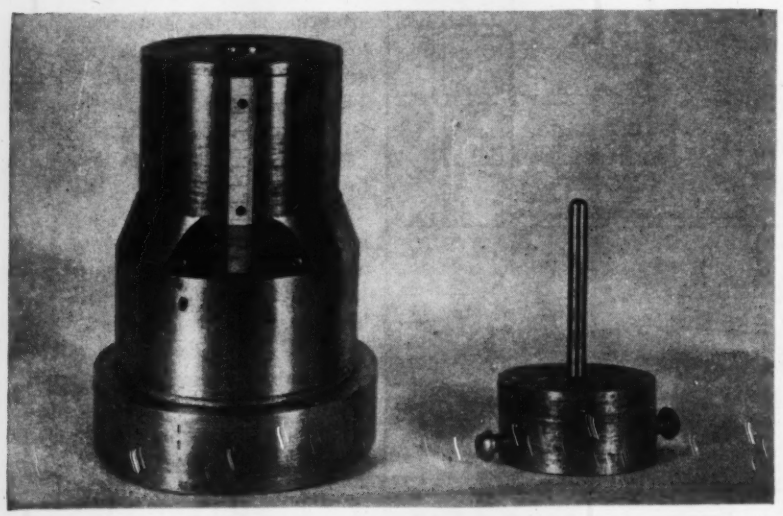


Fig. 1. Spring dynamometer for measuring soil shear at the University of Toronto.

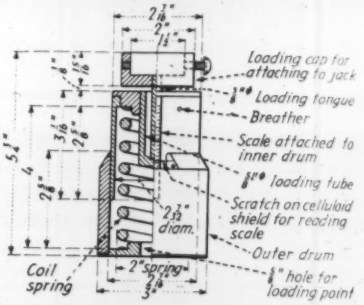


Fig. 2. Details of operating parts of a spring dynamometer.

Calibration of the dynamometers was carried out by placing one against the other to take care of any system of loading. Four curves were obtained, as follows:

(a) The "increasing increasing" in which the total load increased from zero to a maximum, successive increments being approached from below.

(b) The "increasing decreasing" in which the total load increased from zero to a maximum, successive increments being approached from above.

(c) The "decreasing increasing" in which the total load decreased from the maximum, successive increments being approached from below.

(d) The "decreasing decreasing" in which the total load decreased, successive increments being approached from above.

For soil shearing tests the loads were applied as increasing increasing loads only and consequently only the first of the calibration curves mentioned is applicable. On re-calibration after use the instrument was found to give practically the same readings as before. By using a reading glass, loads may be determined to the nearest pound, which is manifestly sufficiently accurate for loads that ordinarily amount to several hundred pounds.

American Roadbuilding in Liberia

A. N. CARTER
Editorial Assistant, Engineering News-Record

***Contents in Brief**—Methods of constructing serviceable roads for heavy traffic around a rubber plantation, using primitive means and local materials, are outlined by the author, formerly on the engineering staff of the Firestone Plantations Co., in Liberia, West Africa.*

ROAD CONSTRUCTION by the Firestone Tire & Rubber Co. in developing its 100,000-acre rubber plantations has created a new standard of transportation in Liberia. In fact it may be said that, with the building of the company's 150 mi. of plantation motor roads and the new 40-mi. highway connecting the plantation with Monrovia, the nation's capital, the country has become road-minded. A roadbuilding program is planned and in fact has already started; during this fiscal year about 35 mi. of road and a dozen bridges have been built and for the year to come the federal program is about the same.

Standards fairly good

As the writer has just returned from work on some of the plantation roadbuilding which set the practice for federal operations, a description of road types and working methods may have interest. Naturally, the methods are quite primitive. Liberia is a country of 43,000 sq. mi. and a population of 2,000,000 made up of fifteen or more tribes or nations having no common language. In 1926, when the plantation company started roadbuilding, the country had less than 50 mi. of roads all within 30 mi. of the capital and over half of the mileage was impassable in the rainy season. Inland, in the hilly and jungle country, only narrow, crooked, unmarked footpaths existed. Moreover, there were no horses or other draft animals to do work.

The plantation company roads are costing about $1,200 a mile with temporary bridges and $1,500 a mile with permanent bridges. The roads are of two classes, main and secondary. In the beginning, the maximum allowable grade was 3 per cent for both types. Due to this restriction and the economy of avoiding unusually large cuts and fills by following the natural contours of the land, an extremely large number of curves was introduced. To make for better alignment, present specifications for main roads are 5 per cent maximum grade, 24-ft. roadway, and 300-ft. minimum vertical and horizontal sight distances. With secondary roads, a 7 per cent grade is allowed, the width is reduced to 20 ft. and the restrictions as to sight distances are the same. With both classes of roads, cuts are wide enough to allow a gutter 1 ft. wide and 1 ft. deep to be dug at each side.

Fig. 1. **Field office of native architecture for road work in Liberia.**

After the profile of the centerline has been obtained and the final grade determined, grade stakes are set at 25-ft. intervals. In fill, the stakes are driven until the tops are above grade a distance equal to the calculated shrinkage. In cuts the procedure is the same except 4-in. holes are first dug and short stakes are driven to grade in the bottom of the holes. Once the stakes are in place, a wheelbarrow crew begins work at the point where there is a change from cut to fill and advances into the cut, dirt being moved at an average rate of 1½ cu. yd. per man-day.

The most common type of soil encountered is a red, ferruginous, porous clay known as laterite and containing a high percentage of stones about the size of walnuts. This soil produces a very serviceable road for heavy traffic. With long fills where borrowpits parallel the road and a poorer soil is encountered it is sometimes necessary to surface the fill with about 6 in. of laterite from a nearby source. In many ways the roads are much more satisfactory than gravel roads in the States and the yearly cost of maintenance is less than $25 per mile. A caterpillar road patrol grader is available for blading the roads before and after the rainy season but most of the maintenance work is done by hand. Keeping the side ditches free of weeds and of earth from sliding banks is the biggest job.

Bridge work is simple

On the roads completed to date there is an average of eight corrugated metal culverts and one reinforced-concrete culvert or bridge per mile. The metal culverts are placed with the first construction work in most cases. The sections must be imported; when there is a shortage, 50-gal. metal drums are

frequently used in building a small culvert where there is a very limited area to be drained. Two parallel walls about 6 in. wide and 1 ft. high are built and the opening is arched over by splitting a number of drums lengthwise and placing the half-sections end to end across the road so as to bridge the gap between the two walls. Using a lean mix, a 6-in. layer of concrete is next placed on top of the metal sections to produce a culvert that proves very satisfactory if covered with sufficient fill.

Usually, only temporary bridges are built at first across many streams because often the drainage area is unknown as well as flood-stage data. Rainfall studies started a few years ago show as much as 7 in. of precipitation in two hours. The abutments and piers of a temporary bridge are pole cribs filled with rock, the openings are spanned by stringers cut from nearby trees and the planks for the roadway are sawn by hand from the large supply of hard timber available. Most of these bridges are built with a one-lane roadway. Such a bridge is easy to construct, and requires few materials, to get which may result in a long delay. The cost to provide a 30-ft. opening may be less than $25. For larger openings, steel I-beams are used for the stringers.

Fig. 3. Sixteen "boys" carrying a bridge stringer. Bridge abutments are stone filled log cribs and the floors are 2-in. hand-sawn plank.

Fig. 2. A grading gang at work with wheelbarrows; when boulders are met, fires are burned on them and then cold water is poured on the hot rock to shatter it.

Various plans are followed to prevent interruption to traffic when the permanent bridges are being built. This work is usually done following at least one rainy season during which observations are made to aid in determining the proper size of culvert or bridge needed. When a concrete culvert is planned for a given stream, the wooden bridge is constructed if possible with sufficient opening and clearance to permit building the final structure in the temporary opening provided. If building the second bridge under the first will result in too great a fill, the wooden structure is often built as part of a short bypass to allow the concrete work to be done later in the open. Bypasses are always built where the size of the stream calls for a bridge with a reinforced deck slab supported by I-beams. On these bridges a 20-ft. roadway flanked by concrete railings is provided and the deck is designed for two 15-ton trucks on the bridge simultaneously.

For the concrete work, reinforcing steel, I-beams, cement and form lumber must be imported. Steel costs 20 per cent more than in the States; cement shows about the same increase and lumber costs are doubled. Good river sand is obtained locally but many hauls are necessary. All other aggregate is produced by crushing a hard granite which outcrops in several places on the plantations, there being no limestone deposits. The cost of the concrete in place averages about $7 per cu. yd., the cost of placing running 50c. and on some jobs as low as 12c. per cu. yd. because of favorable conditions.

To date, only one bridge with steel superstructure has been built. This is a simple 150-ft. span with a 24-ft. roadway. The most interesting construction feature was sinking by hand in quicksand to rock a 15x40-ft. reinforced-concrete, cellular caisson 26 ft. high and sealing the bottom with concrete to provide a safe foundation for one abutment. The necessity of removing solid logs 3 and 4 ft. in diameter that were buried 10 ft. or more below streambed added greatly to the difficulty. The steel for the superstructure was erected from a falsework of native timber set in the river. Two hand winches, a stiffleg derrick built by welding together pieces of scrap iron, and an air-compressor riveter were used. The method of erecting the steel made possible the use of a great amount of unskilled hand labor and cost $2 per ton.

For the Firestone Plantations Co., W. T. Runals is chief engineer of the main office at Akron, Ohio, and Ross Wilson is resident engineer in Liberia. Most design calculations are made in the Akron office.

Probing for Bridge Foundations

N. R. SACK

Bridge Engineer, Missouri State Highway Department, Jefferson City, Mo.

Contents in Brief—Practical methods and tools developed by the Missouri highway department for subsurface exploration for bridge foundations; tools and operating procedure are described in detail for the direction of the field worker.

EXPERIENCE over a period of years in surveying underground conditions for bridge foundations has led the Missouri highway department to settle rather definitely on certain methods and equipment. As these include all the common processes of underground exploration from the surface they have general application that seems to warrant placing them on record. Let the writer emphasize the term "record"; there is much that is pioneering and picturesque, also a little discomfort and risk, in exploring for foundations but they have no part in this article. It is a statement, factual almost to drabness, of working practice wrought out of long experience.

Missouri has as great a variety of subsoils as have perhaps most states; they range from the cavernous limestones of the Ozarks through gravel, sand and clay mixtures to the silts of the river valleys. It cannot be said that any or all of the equipment to be described, combined with good execution of the work by the survey crew, is infallible, but close control and an accurate log of operations, with a trained operator's description of the kind of material, will eliminate uncertainties almost completely. About the only error will come from not exploring far enough to develop all the information that the equipment will provide.

Hand augers most used

Perhaps the most used tool in the Missouri list of equipment is the earth auger. The design that has been found the most satisfactory is the single-twist auger manufactured by the New York Engineering Co., New York City; the single-twist auger is easier to operate and cleaner than is a double-twist tool. For hand operation a 2-in. auger is large enough to indicate the material and not too large for reasonably deep soundings. By careful manipulation the auger will take out the earth with relatively little disturbance; even when water is kept in the hole it will not penetrate the original clays and loams or affect their natural moisture content unduly in the brief contact time between taking samples. The auger is of no value in gravel or in sand; the gravel jams and holes in sand cave in.

Normally the depth of auger boring by hand is limited to 50 ft. The auger must be pulled for each sample of a foot or so in depth and as the hole grows deeper an inordinate amount of time is consumed in connecting and disconnecting the sections of auger rod. The possible depth of auger boring has never been determined in Missouri for when the holes apparently must go deeper than 50 ft. resort is had to casing and machine drilling which take no more time and are much easier.

Sounding rods for deeper holes

For ordinary pile foundations, where it is desired to go deeper than the point at which an auger is useful because sand or gravel is encountered, drive-rod soundings are made. It is fully recognized that with this method the identification of the materials penetrated depends on the experience of the operator in interpreting the "feel" in driving and the identity of the soil that clings to the rod point and couplings and may to some extent be in error, but the method does indicate whether or not piles can be driven, gives the depth to hard strata if there are any and, if carefully logged, gives some indication of the length of piles to be specified.

The drive rods are usually extra-heavy ¾-in. pipe in 4-ft. lengths with extra-heavy recessed steel couplings. The New York Engineering Co. makes solid drive rods having special couplings with tapered threads which have a great advantage in speed of coupling and uncoupling, but because of expense they are used in Missouri only for earth augers. The solid rod coupling is shown by Fig. 2.

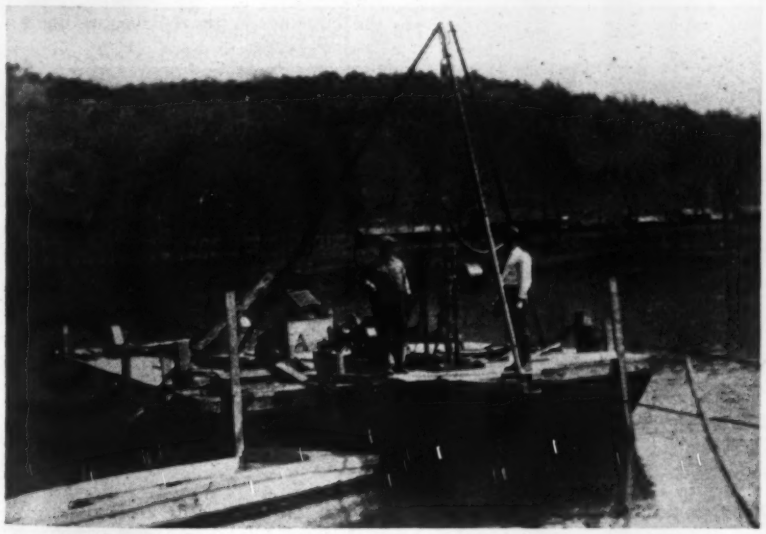


Fig. 1. Diamond drill taking cores in exploring an underwater foundation.

The hammer used to drive the rod consists of a 3-ft. length of 1½-in. pipe capped at one end and filled with tool steel deep enough to bring the total weight to 35 lb. Caution is urged against the use of lead filling; the lead after long pounding swells the pipe and the striking face "cups" and lead sticks to the rod so badly that the hammer has to be put into a fire and the lead melted out and repoured. This is a troublesome operation in the field. Generally the hammer is operated by four men who take turns, working two at a time. Some pull-down is exerted but the principal effort is to strike blows as rapidly as possible and with as high hammer velocity as can be obtained in arm reach. This is breath-taking work and shifts of operators are necessary.

To pull the rod a special jack shown by Fig. 3 is used. The base is 10x18 in. and is slotted to straddle the rod for an axial pull and the lever has a forked end with a cross-pin which carries a chain the free end of which is wrapped around the drive rod in a half hitch so that it can be slipped down the rod for successive lifts. Each lift is only a few inches but the lifts are made quite rapidly. The pull is often quite hard and the strongest ⅜-in. chain that can be bought in the market is required and even it sometimes breaks. A ½-in. chain will not grip small rods.

Churn drilling outfit

The devices so far described are hand-operated ordinarily for exploration to depths of about 50 ft. For deeper holes casing and power drilling are generally advisable, and the methods used are churn or rotary drilling, depending on the material being explored.

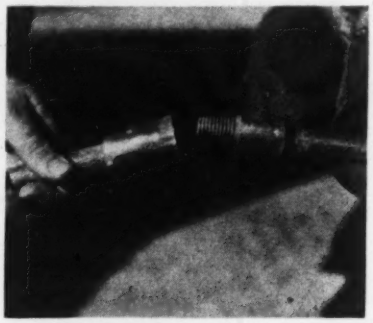


Fig. 2. Quick-acting coupling for solid drive rod used with earth auger; note the shoulders to give a good hold for the wrench.

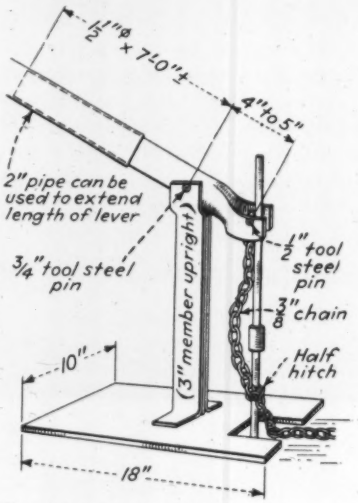


Fig. 3. Jack for pulling drive rods used in sounding-rod tests in ground in which the earth auger is ineffective or consumes too much time.

A churn drilling outfit consists essentially of casing, drill rod and bit assembly, headframe for driving casing and operating the drill rod assembly, a hoist engine and a power pump unit. That used in Missouri is an assembly of special units selected after trying and discarding others; the evolution is informative but first it is important to state that any outfit however got together, must meet certain requirements for road-bridge work. Frequent shifts on the job and from job to job require units that are light and easily moved. Still they must have power, for pumping is often required up to several hundred feet and pulling and driving casing and handling drill rods call for power. The use often of dirty jet water puts hard wear on pumps; in fact hard usage of equipment is characteristic of exploration operations.

The pump unit is the first problem. In Missouri an inboard marine motor and Viking type rotary pump coming with a commercial wash-boring outfit was first used and met all requirements except that in handling dirty water the pump wore rapidly and the engine could not stand up under the rigorous service required of it. A study of centrifugal pumps then disclosed several within reasonable weight limitations but for a 2-in. pump, 150 ft. of 1½-in. pipeline cut the capacity at the jet below that required.

Search finally disclosed a rotary pump (Blackmer Rotary Pump Co., Grand Rapids, Mich., No. 50 L, 2-in.) Fig 4, making use of centrifugal force to keep the fins in contact with the housing. With replaceable liners

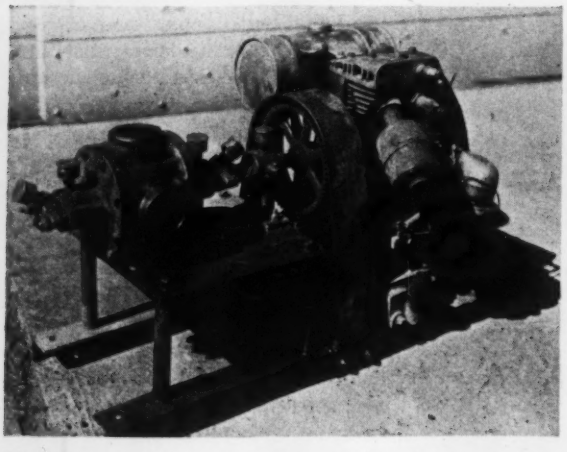


Fig. 4. Pumping unit for churn drill exploration that weighs only 175 lb. and is assembled in the department shops; more recent units have solid gearboxes and gears running in oil.

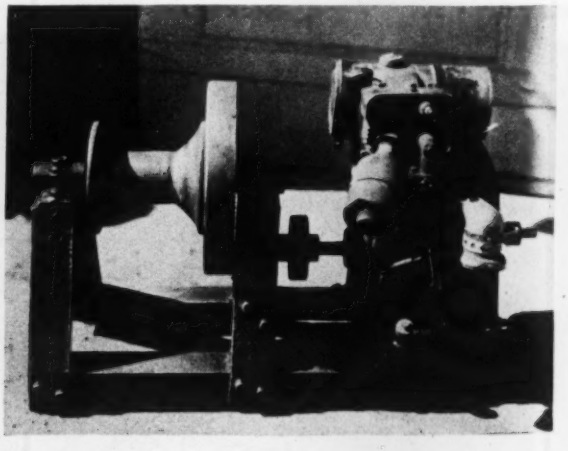


Fig. 5. Hoist engine unit for churn-drill exploration; note internal ring gear on drum shaft. Addition of a 16-in. split pulley and belt converts the unit into a core drilling power unit.

and pins this pump has given good service with reasonable repair costs. The power unit is a Briggs & Stratton, 4-hp high-speed gas engine with a gear reduction of 8 to 1 to the pump. The combined unit weighs about 175 lb.

The experience with casing also went through several steps. A special smooth outside 2-in. special casing was tried first but it required a special hammer and pulling jack and was 10 to 15 times more expensive than ordinary pipe. A regular-weight 2-in. pipe did not stand up under driving and a shift was made to extra-heavy 2-in. pipe. Then when core drilling was tried it was found that any slight bend reduced the diameter so much that a 10-ft. core barrel would not pass. The final change was to a 2½-in. extra-heavy pipe.

This casing is driven in 4 or 5-ft. lengths with a hammer which consists of a steel casing 1 ft. long and 10 in. in diameter with a $2\frac{15}{16}$-in. cored hole. This hammer (Fig. 6) is operated by a hoisting engine with a 2 to 3-ft. drop.

To pull the casing the hammer is set *below* the coupling and strikes upward. In a hard pull a block and double line are used, and while the speed of the hammer is cut in half, it seems to work better. Using a somewhat lighter hammer for pulling is also quite satisfactory. The driving hammer weighs 250 lb. and since in pulling casing the engine has to support the hammer all the time, it loses the inertia it otherwise has for a short pickup and must depend on power alone, hence the double line for pulling.

From 50 to 75 hammer blows a minute can be delivered by the hoisting engine (Fig. 5) which is of the same type as that used for the pump with a gear reduction of eight to one. A simple pipe tripod with a pulley at the apex is used for the headframe. It is necessary to stake the light engine down; also an old hay-rake seat fitted to the engine adds the weight of the operator who pulls and loosens the hammer rope. Incidentally, a cast-iron nigger-head for the hammer rope is found to wear longer than the pressed steel pulleys first used.

The drill assembly consists only of double extra heavy 1-in. pipe (to furnish weight) with the chisel bits shown in Fig. 7 and a water connection on one end of a T at the top. A Timken type-J bit is now used instead of the one shown by Fig. 7c, as it costs about 30c. and the temper is exactly right, always uniform and lasts much longer. The bit shown in Fig. 7c costs from $5 to $7 to make and uniform temper is hard to obtain with a variety of blacksmiths. This drill assembly is raised by a rope around the hoisting drum and dropped to deliver the blow. A constant supply of water through the drill stem and out of the bit keeps the material flowing out of the casing at the top, and a tee is used at the top to control the flow of water. Samples are taken of outflow and analyzed by inspection or later by laboratory methods.

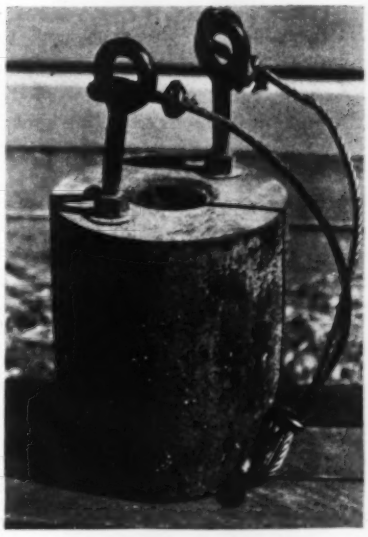


Fig. 6. Hammer for driving casing is raised and dropped by the drum on the hoist engine; eyebolts fitted loosely and tightened with lock nuts; long bolt shafts permit rethreading since breaks under lock nut are frequent.

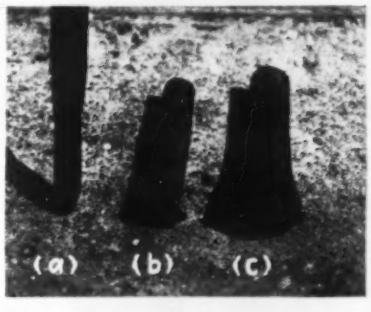


Fig. 7. Bits used for churn-drill exploration; (a) driving point a solid rod welded into the end of the ¾-in. drive pipe; (b) jetting bit with hollow stem and jet holes on each side; (c) original chopping bit now replaced by Timken J bit.

Fig. 8. Hand winch considered one of the most indispensible machine units in an outfit for subsoil exploration; a one-ton machine is large enough.

Sampling involves two uncertainties: First, the material is brought up mixed with water and all knowledge of the original moisture content is lost; and second, the driving of the casing compacts the material so that in driving the casing 5 ft. the depth of material found inside is seldom more than 2½ ft., and often is less. To be somewhat certain of original depths of strata therefore experience has shown it to be necessary to take a sample for every 2½-ft. drive. Because of these uncertainties a careful log of operations is insisted on, including the depth to which casing is driven each time, the depth at which jetting started at that individual operation and the depth to which jetting is carried. A record of every occurrence is essential.

Core drill practice

While the churn drill can be used to penetrate rock to almost any depth, a core drill is generally faster. A commercial rig is preferable for core drilling; that used is a Sullivan Bravo. This is no longer made but improved machines have replaced it and full descriptions are available from manufacturers. Here discussion is confined to experience with drill bits, practically all types of which have been used in Missouri work, and descriptions of which are simply a matter of catalogue study.

The size of bit used is 1⅛ in.; this does not cost greatly more than $1\frac{5}{8}$-in. bit and the percentage of core recovered is far greater. A regular diamond bit of this size costs about $1,200, which makes a valuable enough tool to be carefully handled. The stones are set in a plain bit of

soft Swedish iron and when the metal is worn too much the stones should be reset, and this is a skilled operation. To overcome this disadvantage of the diamond bit the manufacturers in the past few years have developed a Bortz bit which consists of small chip diamonds set over the bottom and rounded shoulder of the bit; this bit sells for about $120. It is quite foolproof and it will operate in any rock except sandstone. No highly skilled servicing is necessary with the Bortz bit and when the bit is worn out a new one can be obtained frequently in less time than it takes to have the diamond bit reset. For hard clays and shales a tooth bit will be found satisfactory, and for sandstone a shot-drill such as is employed to cut cores from pavement.

Servicing equipment

A field party must be equipped with pipe-fitting tools, including pipe vise, wrenches, pipe cutters, and threading dies for all sizes of pipe. Small tools are carried in chests having weatherproof tops and small enough to be handled by two men. A flat-bed, stake-body truck with removable tarpaulin top provides the most usable equipment for transport, especially since this permits work from the truck which a closed body would not. With a tripod mounted on the truck, loading and unloading is made easier with a hand winch. This hand winch (Fig. 8) is almost indispensable for work in deep water, to handle anchors, pull the barge in final position, and handle the long assemblies of casing which are necessary to reach bottom.

Since the party must carry personal baggage along, as well as transportation for five or six men, it is desirable that it be equipped with a smaller vehicle, which is used to transport the party back and forth from town to the work, make extra trips for supplies, and carry baggage on moves from job to job. In addition, this car enables the party chief to take one or two men in advance of the truck, locate and stake out the work on the next job so that the party can start actual soundings when the truck equipment arrives at the ground.

An Important Tunnel Lining Study

Contents in Brief — Porcelain-enamel steel tile found good after nine years' service in Detroit tunnel walls. Tile show no corrosion except where knocks have chipped enamel. Use of timber furring recommended instead of attaching tile directly to concrete.

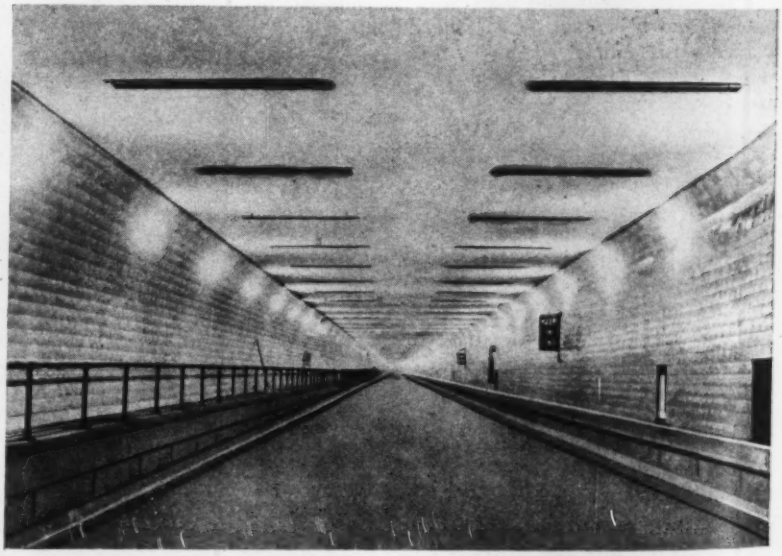
GENERALLY EXCELLENT condition of the porcelain-enamel steel tile lining of the Detroit-Canada vehicle tunnel after nine years of service is attested in a report made by the Robert W. Hunt Co., inspection engineers, of Chicago, Ill. The accompanying illustration is an interior view of the tunnel. Richard H. Vose, of the Hunt organization, who supervised the inspection work, summarizes the findings as follows in the covering letter accompanying his report:

> Our observations of the present condition of the porcelain-enamel steel tile in the Detroit-Canada tunnel, together with information on conditions of installation, exposure, replacement and service, lead to the conclusion that porcelain-enamel steel tile can be furnished which, properly installed by competent craftsmen, will form a lining eminently suitable for all of the requirements of subaqueous vehicular tunnels.
>
> The tile examined in place in the tunnel or removed indicate no corrosion whatever has taken place on the tile except where unnecessary outside mechanical abuse has exposed the base metal to moisture, and we find no deterioration which can be charged directly to the type of material.

The lining of the tunnel consists of porcelain-enamel steel panels or tile 12 in. long and 6 in. wide. There is a slight convexity or crown to the exposed side and the edges are turned back $\frac{8}{8}$ to $\frac{7}{16}$ in. and somewhat more than 90 deg. with the face. The porcelain-enamel finish is composed of inorganic materials such as silica, borax, soda and other mineral substances. This mixture, known as frit, was fused to the 20-gage enameling sheet base by firing at 1,500 to 1,600 deg. F. A ground coat and two cover coats of enamel were applied to the metal. The finished product presents a surface impervious to moisture and to temperature variations under ordinary conditions of service.

Blames structural faults

Mr. Vose points out in the body of the report that the heavy construction of the tunnel and the manner of its installation has had considerable



Interior of the Detroit-Canada Tunnel, showing the porcelain-enamel steel tile lining.

effect on the condition of the porcelain-enamel lining during its service to date. The report states:

This tunnel consists of the two approach inclines built by cut-and-cover which are practically in the dry; the two tunneled sections were constructed by shield methods, and the long central tube was constructed in sections of about 248 ft. and sunk in place below the river bottom, after which the tube was more or less covered with concrete by tremie.

At the joints between the approaches and tunnel section there is some leakage. Leaks have also developed at the joints of the several tube sections and at the junction of tube and tunnel. While the total amount of water pumped from the tunnel daily is small, there is a constant localized seepage.

This seepage is through the outer concrete, through leaks in the tube and through the inner concrete lining, so that large areas of the concrete are constantly water-soaked, and not only the metal of the tube and tunnel lining is exposed to the water, but also the reinforcing steel in the concrete of the lining and roof slab.

The water which comes through the tunnel walls mostly near the roof slab is in places thoroughly discolored with iron rust and in other places, while free from iron oxide, contains some form of lime in solution, probably from the concrete.

Due to these conditions the report states that tile are forced out by frost from behind and fall out when the frost thaws or are so out of surface that they must be replaced. This requires the removal of the tile, and the same condition will produce the same effect on other forms of lining. Where leaks are evident and much seepage comes through, tile are removed to get at the concrete for repair, and new tile must be used as replacement, as many will be injured in breaking out. This will be the same for any type of lining.

Some deterioration was noted in the porcelain enamel tile in place when inspected. However, all forms of such deterioration were, according to the report, due to unnecessary outside influences. They resulted largely from hard blows and other injuries due to forcing the panels into place or trimming the edges when they were first installed. In this connection the report stresses the value of careful installation methods.

Maintenance procedure

In describing the maintenance procedure for the porcelain-enamel lining, the report states that the tile faces are washed periodically by spraying with a solution which cleans off the condensation moisture, rusty stains and accumulated soot, but the hard deposits from the precipitation of solids from the water are removed by scrapers and steel wool. The restored surface is perfect and shows excellent reflectivity.

The maintenance work carried on beside the regular cleaning consists in replacement of such tile as have been pushed out by frost action during the winter and the removal of tile where leaks show, in order to fill the cracks in the concrete behind the tile. The tile are then replaced with new.

The total of replacements appear to be something over 400 annually, about equally divided between replacing the displaced tile and repair over areas uncovered to repair concrete. As there are some 220,000 tile in the lining, this replacement is about 0.2 per cent yearly.

The report recommends that furring strips be used between the concrete and the porcelain-enamel panels, a practice now generally followed in the erection of porcelain enamel for building fronts, wainscoting and other architectural uses. In discussing this recommendation Mr. Vose points out that furring out from the concrete would allow drainage space behind the tile. The report states that if this had been done in the Detroit-Canada tunnel, there would have been no displacement of the tile by frost action and "a perfect surface could have been obtained and retained."

Artesian Water Pressure Lifts Dam

An unusual example of the effect of the elasticity of water-bearing rock is afforded at Conchas Dam, N. M., where the natural recharging of the artesian foundation rock following a lowering of the water table during construction has caused the dam to rise a perceptible amount. This phenomenon, which was briefly reported in our account of the A.S.C.E. convention at Chattanooga, Tenn., (*ENR*, Apr. 27, 1939, p. 560) is discussed in some detail in a report made at the annual meeting of the section of hydrology of the American Geophysical Union in Washington, D. C., by David G. Thompson, senior geologist of the U. S. Geological Survey and chairman of the committee on underground waters of the section. Mr. Thompson quoted from a statement by T. V. Thies of the U. S. Geological Survey, who is participating in an investigation at the dam site.

The main section of the dam is a concrete gravity structure, placed in separately movable monoliths about 200 ft. high, and founded on an artesian sandstone extending about 40 ft. below the base of the dam which in turn rests upon about 30 ft. of dense shaly material lying upon artesian sandstone in excess of 100 ft. thick. As the dam neared completion, it was noted that these monoliths had settled a maximum distance of a little over two inches. Some time later certain of the monoliths began to rise, and a maximum lift of about one inch was noted. This rise was observed during the period of recovery of artesian head after the unwatering of the foundations and immediately followed an extended period of high pressure grouting at the heel of the monoliths. The area of distribution of the rise in this section of the dam is said to conform closely to the distribution of the increased hydrostatic pressure caused by the grouting and the recovery after pumping.

A point of interest, reported Mr. Thies, is the fact that from laboratory determination of the moduli of elasticity of specimens of the artesian sandstone it seems improbable that expansion and compression of the sandstone itself under the known changes of hydrostatic head could account for the rise and fall observed. Accordingly, the characteristics of the underlying shale are being carefully studied. Preliminary tests of specimens of this shale examined in the laboratory have indicated that it is possible to expand and contract it by increasing and decreasing the hydrostatic pressure imposed on it without changing an externally applied load. The data available at present indicate that the elasticity of this artesian sandstone is due to the "included shaly bed."

Elaborate equipment is being installed to study subsequent movement of the foundation, and accurate surveys will be made periodically to determine change in elevation of benchmarks in each monolith. It is expected that there will eventually be obtained a very instructive and detailed record of the effect of loading an artesian aquifer.

Service and Supply Yard Planning

W. R. JULIANELLE

Architect, Office of the City Engineer
New Haven, Conn.

***Contents in Brief**—Every department of public works has a supply yard or field headquarters for storage of materials and housing of equipment. Few of them, however, are designed with regard to function and accessibility. Elements to be considered in planning a supply yard, and how they were applied in New Haven, are described.*

A MUNICIPAL SUPPLY YARD is the field headquarters of the department of public works. Its primary functions are to serve as a storage place for materials and to house and service equipment belonging to the department. Supply yard design and conception will depend on the size and needs of a community and will reflect personal inclinations of the designer. It may contain but one service building, commonly known as the town garage, or it may be an elaborate group of service quarters. And in large cities there may be several branch yards at various points in the metropolitan area. But regardless of size, supply yards differ chiefly in details. Basically, they serve the same ends and certain general requirements may apply to all cases.

The following discussion of supply yard planning is the result of a detailed survey of facilities in several communities. This study was made for the purpose of obtaining information which could be applied in the design of a proposed supply yard for the New Haven department of public works.

Broadly speaking, the elements of supply yard planning group themselves into four general classifications. These are: (1) the storage unit in which materials and equipment are housed; (2) the servicing unit, which concerns itself with general repairs and the servicing of equipment, tools, etc.; (3) the administrative unit, in which facilities are provided for the planning and supervision of daily tasks; and (4) the labor unit, which executes these tasks.

The storage unit

The storage unit may be considered the primary element of the supply yard. Further elaborations grow out of this one motivating requirement. No supplies are stored in a permanent resting place and then forgotten. They must be moved, transported and hauled from place to place—ceaseless movement is the business of the supply yard.

It is necessary, therefore, to give careful consideration to a methodical and systematic arrangement of the storage spaces so that there may be an accurate knowledge of the number and quantity of the supplies as well as complete supervision over their entry and removal. Supplies must be easily accessible to facilitate their prompt usage without interfering with the other activities of the yard, and they should be properly housed for shelter and to protect them from vandalism.

An ideal solution would be to house all materials in closed, and perhaps heated spaces, but for budgetary reasons this is not always possible. Some materials, such as lime and cement, will deteriorate upon exposure, and therefore must be stored in a weatherproof shelter. And sand used on icy pavements should be kept dry and heated above the freezing point for easy spreading.

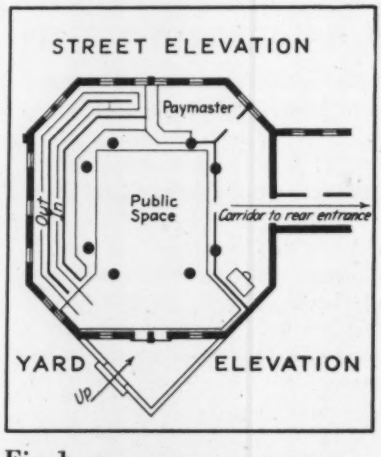


Fig. 1. Paymaster's area in the entrance lobby is spacious and has railed passageways to minimize confusion.

In planning the storage spaces the nature and use of the materials should be considered. Sand is one material which always presents a special problem because of the advisability of devising labor and time-saving methods for handling it. In Stratford, Conn., (pop. 19,000) an ingenious storage scheme has been devised. Behind the retaining walls which separate the street from the lower level of the yard, bins were constructed which follow the principle of a fireplace chimney flue with ash dump and cleanout door. Sand is poured into the bins through manholes at the upper level and removed, when needed, through hoppers at the yard level. But since each bin holds little more than a cubic yard of sand such a method is practical only for a small community.

In Springfield, Mass. (pop. 150,000), the method of storing and unloading the ingredients used in asphalt mixing might easily be adapted to sand storage. A concrete trestle was built next to an elevated railroad siding on which the materials are received. Trucks drive under the trestle at the yard level and are filled from bins located above in the trestle itself. A two-leveled site will facilitate the planning of such novel features, but an ingenious designer should experience little difficulty in developing a method regardless of topography.

Relative to materials storage, the desirability of providing a laboratory for testing materials should not be overlooked. This can be of real value and warrants the additional expense in safeguarding the community against receiving inferior products.

The servicing unit

Planning for tool and equipment care, particularly automotive equip-

ment, should include more than making provisions for its storage. Housing for equipment should include ample space for making repairs, together with machine shop, greasing pits and stockroom facilities. At least one forge should be provided for general blacksmith work.

The storage room for automotive equipment should be heated to insure prompt starting of engines during cold weather. Provision should be made for tire repairing, battery recharging and servicing, and gasoline distribution. It is advisable to include space for washing cars.

An asphalt mixing plant is not always required as this need is contingent upon the manner in which each community handles its paving program. Some cities, such as Springfield, Mass., manufacture their own asphalt for all paving jobs, and, consequently, have adequate facilities for this purpose. In New Haven, on the other hand, ready-mixed material is bought on new paving projects, but for small patching and repairs the material is mixed and stored in the supply yard.

Administration and labor

The administrative unit of the supply yard provides working space for the clerical and office staffs. The number and functions of the staff depend, of course, on the size and scope of the department of public works activities. This unit, serving as the executive arm of the field headquarters, receives and checks materials and equipment, looks after the needs of the supply yard, supervises its functions and handles the payroll of its employees. It is preferable to house these offices in one building conveniently located near or at the main entrance to the yard, but some of the minor offices (storekeepers, stockroom clerks, etc.) can be located at the site of their domain.

The labor unit concerns itself with personnel requirements. For the convenience of the permanent workers a large employees' room, complete with lockers, toilet and washroom facilities and showers, is recommended. In localities where snow removal is an item provision should be made for handling large emergency crews. At New Haven, for instance, snow removal needs increase the working crew to such overwhelming proportions that it becomes a problem to deal with the payroll.

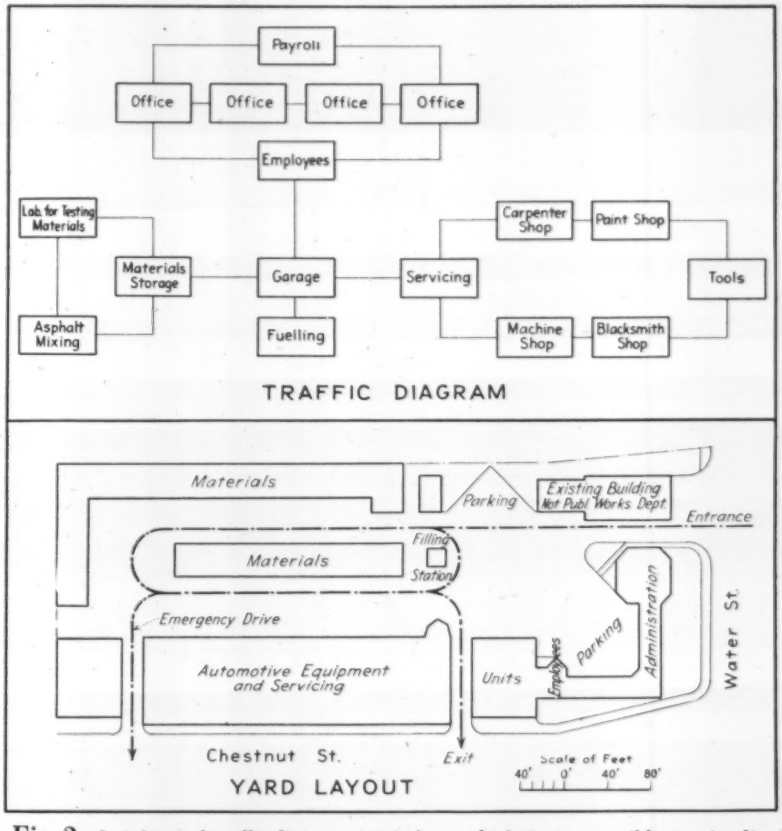


Fig. 2. Supply yard traffic diagram (top) from which it was possible to visualize the grouping of activities, and (bottom) the final layout.

On the proposed new yard layout (Fig. 1) the paymaster's area, which also acts as the entrance lobby and waiting room of the administration building, is a large room designed like the public space of a bank. The paymaster's window is approached and left by two different railed passageways to insure an orderly line and minimize crowding. To facilitate the handling of emergency payrolls, the room may also be entered through the rear of the building, by way of our main corridor. This permits a long line to form within during inclement weather.

It is evident from the above that the functions of a supply yard are complex and varying in nature. In the solution of our problem in New Haven it was found desirable to study these activities according to their similar and correlative features by means of a traffic diagram (Fig. 2). By grouping various activities into units it was possible to visualize the workings of the supply yard and so approach the problem of circulation and control with logic.

The result is shown in Fig. 2, which is a diagrammatic representation of the proposed layout showing the control points and the general lines of traffic. The location of the filling station is particularly significant as a point of control. This site commands a good view of the yard and acts as the night watchman's station from which point he can control the lighting of the yard.

The functional success of a supply yard layout depends on the thought and consideration given to administrative control and supervision over the work of the yard and to unimpeded circulation as a desirable objective. Entrances and exits should be so placed that they may be easily supervised. The general plan should consider well regulated traffic with little danger of tie-ups and confusion. Emergencies frequently arise in the normal routine of the yard where speedy and efficient handling of equipment and materials will be an invaluable asset.

The study of supply yard planning on which the article is based was made by the writer under the direction of W. Vincent Barry, city engineer and acting director of public works of New Haven.

Three-Point Problem Simplified

LYNN W. JONES and BURTON W. BASTEN
University of Redlands, Redlands, Calif.

Contents in Brief—Reduced effort is required and exact results are given by use of a new solution for the 3-point plane-table problem. Only two "triangles of error" are required, and these can be constructed with a minimum of survey party footwork.

SIMPLICITY of application together with exact results are the advantages of a new method developed by the authors for solution of the 3-point problem for locating and orienting a plane table in survey work. For many years the U. S. Coast and Geodetic Survey and many other agencies, both public and private, have been using cumbersome methods of locating the plane table in their topographic work.

The 3-point problem occurs when it is desirable to establish on the plane-table sheet the location of the uncontrolled point occupied. With three plotted points visible it is possible to establish this point by several methods, of which the new one proposed in this article is believed to be the most direct.

The two best methods used so far are the Bessel inscribed quadrilateral method and the Lehmann or Coast Survey method. Bessel's method, the more exact of the two, has fallen into disuse because the constructions are so complicated that they are impractical for field work, and because often an intersection of two lines, which is necessary for the solution, lies off the plane table. Thus in actual practice it is rarely used even though it is a theoretically exact method.

Lehmann's method is the one which has been used by the U. S. Coast and Geodetic Survey for the past sixty years. It is the method most widely used by experienced topographers. In actual practice it is fairly rapid but nevertheless it is fundamentally a trial-and-error method. The instrumentman approximates the proper orientation and resects through the three charted points to their respective field locations. A "triangle of error," in general, will thus be formed and by following a prescribed set of rules the direction of error is estimated. The table is then turned in the proper direction so as to reduce the error and the process is repeated. Each time the true location of the desired point is more nearly approached. After perhaps three trials an experienced surveyor will have reduced the error location of this desired point to within the limits of accuracy of the survey being conducted.

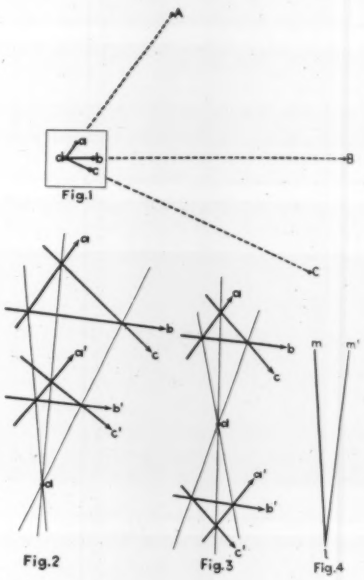
The three-point situation, then, is that there is one method which is exact and impractical and another which is practical but inexact.

After searching fruitlessly through governmental bulletins, surveying texts and other sources for a method both practical and exact, the authors felt that original work on the problem might bring forth a solution that could be both exact and practical. The procedure which follows entails less steps than the Lehmann solution and it is as exact as the Bessel.

Procedure

The plane table is set at the position in the field where it is to be used. A necessary stipulation is that three previously charted points must be visible from the new location. The table is leveled and approximately oriented; then the alidade is pivoted about *a* (Fig. 1) and sighted on point *A*. Line *ad*, of indefinite length, is drawn. The alidade is then pivoted about *b* until *B* is sighted, and *bd* is drawn. Similarly line *cd* is constructed. In the general case, when the point *d* is neither near the great circle through *A*, *B*, and *C*, nor near any of the three range lines *AB*, *BC* and *AC*, a triangle will be formed if the table is imperfectly oriented. This triangle is represented as that one formed by the arrows pointing at *a*, *b*, and *c* (Figs. 2 and 3).

Next the table is turned slightly, perhaps 10 deg. and the procedure is repeated. This time the triangle formed is represented by that one bounded by the arrows pointing at *a'*, *b'* and *c'* (Figs. 2 and 3).



Figs. 1-4. Drawings showing location of plane table with respect to the three points, and the possible constructions that can be used to find the point desired.

Thus there are constructed two similar triangles on the plane-table sheet. By joining the corresponding vertices of the two similar triangles with three straight lines, the true position of the desired point on the map will be indicated by the point at which these three lines intersect. With the establishment of this point, orientation of the plane table can take place.

Application

In practice it is often necessary for a member of the party to go to each of the three points and point out to the instrumentman the location of the station. If the three points to be sighted are some distance apart, it is either necessary to send a separate man to each station, or else one man

to each of the three stations twice (once to form each triangle above described). To eliminate this inefficiency, the following addition to the procedure is proposed.

In an unused section of the plane-table sheet establish temporarily a small angle of perhaps 10 deg. (Fig. 4), each side of the angle being long enough to make possible setting and resetting the alidade accurately along either side. After the table has been leveled and approximately oriented, the alidade is placed along "*lm*." It is then sighted at a distant object, *E*. With the table in this position the line *a* (Fig. 2 and 3) is constructed in the proper manner. The alidade is then placed along *lm'* and the table turned until point *E* again is sighted. With the table in this second position, line *a'* is constructed in the proper manner.

The assistant is then motioned on to the succeeding station. Before moving the table (while line *lm'* is directed at *E*), line *b'* is constructed in the proper manner. The alidade is then turned until *E* is again sighted. Now line *b* is constructed in the prescribed manner.

In a similar manner lines *c* and *c'* are formed by sighting at point *C*. Thus the two triangles necessary for the determination of point *d* will be formed simultaneously, and the assistant will have occupied each point but once.

Advantages of this solution

This solution of the 3-point problem has many advantages over the methods now in use or any which has previously been proposed. Comparing it with the Bessel and other exact methods one finds it, like them, to be an exact solution but unlike them it is simple enough to be practical in the field. By proper technique, which is soon acquired, an operator can always keep constructions inside the limits of the plane-table sheet. The solution does not require any memorization of complicated processes which may not be understood. It is a logical solution based on the idea that the "triangles of error" used in the Lehmann method keep diminishing as the table becomes more nearly properly oriented until at the instant of proper orientation the triangle becomes a point. As the table passes the proper direction of orientation the triangle inverts itself and then increases. Consequently since it is easily understood the method will not be as tedious to memorize.

In the Lehmann method it is necessary to determine whether the table is set up within the great triangle formed by the field locations of the three charted points, within one of the three segments formed by this great triangle and the great circle of the triangle, or without this great circle. This determination is often difficult to do correctly. In this new method no such determinations are necessary. As in the Lehmann method, however, it must be said that this method does not propose a solution for the case when the table is on the great circle nor when the table is near a range line. If, after following the prescribed procedure to obtain the two triangles, the observer has found two points (instead of triangles) or two nearly parallel lines, he knows that he is located on the great circle or near a range line, respectively. In the Lehmann solution it happens frequently that more than two sights must be made to each point, and no such method as suggested above can be used to minimize the work and time necessary. In this new solution never more than two readings on each of the three points are necessary.

It should be added that care should be taken in the procedure so as to keep the two triangles of error sufficiently far apart to give great strength of figure and yet not bother other work on the plane-table sheet. Technique for the elimination of these possible difficulties, however, will be acquired quickly.

Iron Removal and Zeolite Softening

GROUNDWATER generally contains dissolved minerals that cause hardness, and many of the waters contain iron, and sometimes manganese also, both of which cause staining of plumbing fixtures and of fabrics during laundering. Treatment of such waters for removal of iron and softening by zeolite treatment is discussed by H. A. Spafford, assistant sanitary engineer of the Illinois State Department of Public Health, in *Over the Spillway*, a bulletin issued by the department. An abstract of this paper follows:

Treatment for the removal of iron takes advantage of the fact that dissolved iron has a water affinity for oxygen, and when this demand is satisfied, practically all the iron is converted into small particles which can be removed by settling and filtration. Equipment consists usually of an aerator followed by a settling basin and sand filters. The common coke-tray aerator is probably the least expensive, requires very little pumping head to operate and produces satisfactory results. In Illinois, it has proved to be more satisfactory than aerators of the pressure type. Open aerators should be screened with wire cloth, not less than 24 mesh per inch, to reduce contamination from birds and insects. If the water contains sulphur gas, copper screen will soon deteriorate and it is recommended that screen woven from alloy metals high in nickel and chromium should be used. If the water is chlorinated in conjunction with filtration, this screening of the aerator may not be necessary.

Some waters may contain dissolved organic matter and manganese which tend to prevent the iron from precipitating. Then the addition of a small amount of lime or other alkali may be necessary, immediately after aeration.

Removal of iron may be accomplished also with zeolite, but the iron must be in a completely dissolved state and the water must be discharged from the well pump directly to the zeolite in a closed pipe system without exposure to the air. Otherwise, oxidation of some of the iron to insoluble particles will cause clogging of the zeolite. Even passage of water through more than a few hundred feet of pipe may give sufficient exposure to retard operation.

Zeolite is used either in open gravity beds or in closed steel tanks for pressure operation. In either case it is supported upon layers of graded gravel with an underdrain system as in sand filters. Water passed through zeolite is softened to practically zero hardness, but such a condition is not desirable or economical in a public water supply; consumers do not like it, since it feels "slick" and when used with soap difficulty is experienced in rinsing away the suds. Public water supplies having about 85 ppm or 5 grains per gallon of hardness are most desirable, and this condition may be produced by by-passing a certain proportion of the water pumped.

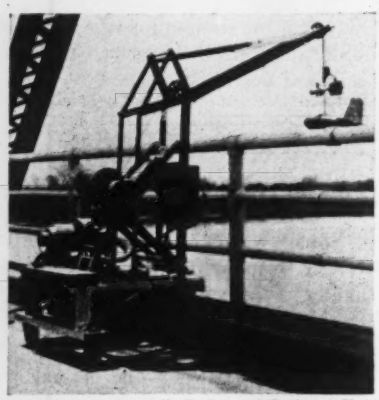
FROM FIELD AND OFFICE

Working problems and time-saving methods . . . Edited by Charles S. Hill

Crane for Current Meters

CARL VERNON YOUNGQUIST
District Engineer, U. S. Geological Survey
Columbus, Ohio

The portable crane with an electrically driven reel recently developed by engineers of the water resources branch of the United States



U. S. Corps of Engineers Photo

Mobile crane operates current meter from bridge floor.

Geological Survey constitutes the latest improvement made by the survey in its equipment for measuring the discharge of rivers that are deep and swift. This crane and reel shown in the accompanying illustration has been designed for easy and quick transportation from one streamflow measurement station to another, as the total weight of the unit consisting of the electrically driven reel, crane, operating truck and motor generator is only about 350 lb.

The power supply for the electric motor which drives the reel is furnished by a 2½-kw. gasoline motor-generator unit. The motor generator is mounted on the small truck at the left side of the crane and weighs only 135 lb.

The 110-volt a.c. or d.c. series wound motor is able to develop 1 hp under continuous operation or 2 hp under a 15-min. rating. Tests of the electrically-driven reel with various weights show that it will raise a 100-lb. weight 4.2 ft. per sec., a 150-lb. weight 4 ft. per sec., a 200-lb. weight 3.8 ft. per sec., and a 300-lb. weight 3.2 ft. per sec. The speed is controlled through a resistance box by four contacts that successively engage a knife-switch as the switch is pushed inward, thus varying the speed. These contacts permit the raising of the current meter and weight at various speeds and allow it to be held at any desired position. This crane and reel was used on March 15, 1939, in making flood measurements of the Maumee River at Waterville, Ohio.

In the design and testing of the crane and electrically driven reel, H. E. Cox and E. H. Curtis, assistant engineers, United States Geological Survey, rendered valuable assistance. Prof. O. D. Richley, Ohio State University, checked the design and assisted in the construction of the first model. Assistance in design, testing and financing was also received from the Corps of Engineers, U. S. Army, through the Nashville office.

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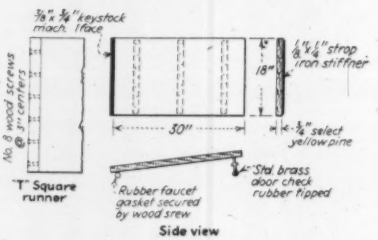
Desk Drawing Board


3/8" x 3/4" keystock mach. 1 face
No. 8 wood screws @ 3" centers
18"
1 1/4" x 1/8" strap iron stiffner
30"
3/4" select yellow pine
"T" Square runner
Rubber faucet gasket secured by wood srew
1" Std. brass door check rubber flipped
Side view

This drawing board can be made anywhere for $2.50 and can be carried and used in any place where there is a table or desk—S. R. ROBERTS, *Field Engineer, Okanogan County, Okanogan, Wash.*

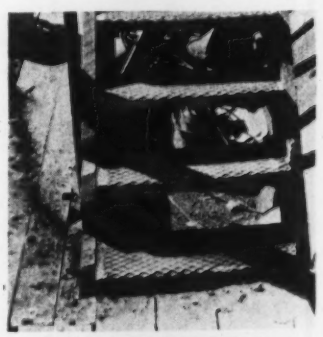
• • •

Forms for Drains

Drainage outlets leading downward from the low point on the surface of each concrete block at Grand Coulee Dam are used to carry off washwater and waste material sluiced out in the process of cleaning off the surface preparatory for the next pour. These outlets, 8 in. in diameter, have to be carried upward through successive lifts of concrete to maintain continuity in the drainage system. The wooden forms originally used for this purpose had a tendency to swell and stick and they have been replaced by collapsible steel forms which are simply lifted up each time a new pour is to be made.

Collapsed cylinder is being removed from the drainage opening to be raised 5 ft. to continue this opening through the next succeeding pour.

The collapsible form is a cylinder 7 ft. long made of 10-gage metal. It has a longitudinal split covered by an overlapping piece of metal welded along one edge, thus continuity of the cylinder wall is maintained with the split opening either wide or narrow. Down the center of the cylinder is a 1½-in. steel rod to which are fastened five 3-spoke spiders which act as toggles. Rotation of the central shaft which actuates these spokes expands or contracts the diameter of



CAMERA MEMORANDA

Steps at Hiwassee Dam are covered with sheets of expanded metal to prevent slipping.

the cylinder. Extreme positions made a ½-in. difference in the diameter.

The 7-ft. lengths permit 2 ft. of the cylinder to remain in concrete previously placed while a 5 ft. length projects for the ensuing pour. When lifted to a new position three No. 9 guy wires are used to hold the cylinder until concrete is poured around it. The cylinder is always set so that the screen at its top will be flush with the surface of the concrete in the succeeding pour. The central rod which projects through the screen, carries a ring to which the hook of the lifting jack is attached after the cylinder has been collapsed.

• • •

Checking Level Notes

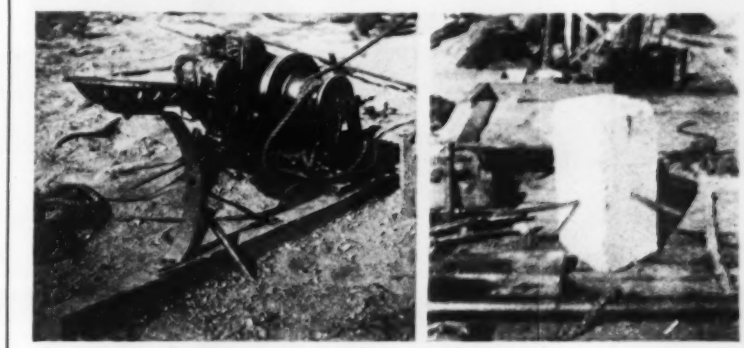
WM. G. HUYSMAN
Delphos, Ohio

A simple method of checking computations of level notes found particularly helpful in the field is as follows: Since the algebraic sum of the foresights and backsights must equal the difference in elevation between any two points, it follows that the difference between the foresights and backsight at any turning point must equal the difference in elevation of the two HI's related to the point. The following is an illustration of the use of this method:

Sta.	B. S.	H. I.	F. S.	Elevation
B. M.	5.821			175.326
		181.147		
T. P.[1]	6.253	*4.118*	2,135	179.012
		185.265		
T. P.[2]	8.239	*3.501*	4.738	180.527
		188.766		

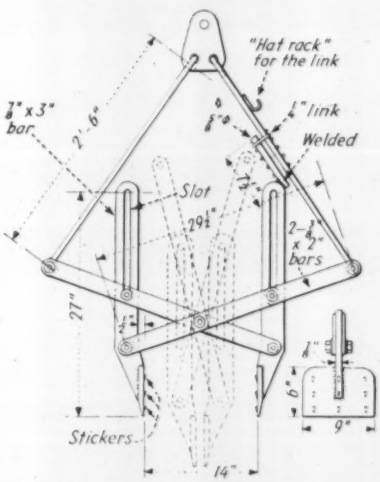
Handy Tongs for Timber

A pair of tongs that have proved to be very handy for picking up short timbers has been developed in the Copper Queen branch of the Phelps-Dodge Corp. along lines shown in the accompanying sketch. Timbers up to 14 in. wide can be picked up quickly with this device, whose jaws need only to be placed over the timber to be lifted; a pull on the single lifting cable tightens the jaws so that the load is clamped firmly. The stickers project enough to give a firm hold without penetrating the timber more than ⅜ in. A link holds the jaws open until an attendant releases it.



CAMERA MEMORANDA

The man who operates a churn drill by loosening and tightening a line on the niggerhead of a light engine gets comfort and lends his weight to the engine when a hay-rake seat is provided, as shown by the illustration at the left. This is a notion of the bridge division of the Missouri state highway department. Another device used when sounding from scows is the concrete block anchor shown at the right. The sandy bottoms of Missouri rivers often bury metal hook-anchors beyond recovery and the loss is expensive. These concrete blocks cost only $2 to $3 and can be cast loose, if buried.



Self-gripping tongs for lifting timbers.

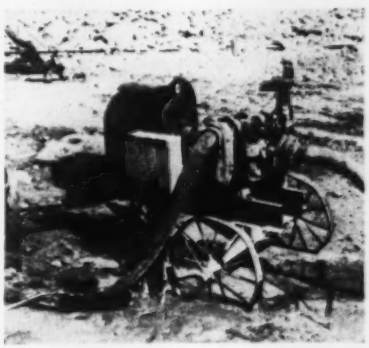
• • •

Kitchen Pump Primes Centrifugal Unit

K. N. BANTHIN
Crivitz, Wis.

During construction and repairs on a hydro-electric power plant it was necessary to move the pumping equipment frequently. The materials handled by the pumps varied from clear water to a sandy slurry and the impellers and cases of the pumps became worn and the pumps would not prime themselves. Near the center of operations water under pressure was used to prime the pumps; in other locations priming became a problem that had to be solved as cheaply as possible.

The solution was the installation of a regular kitchen-type pitcher pump on the intake side of the centrifugal pump case. A 1-in. pipe hole was drilled and tapped in the pump casing and was fitted with a nipple and removable bonnet-type globe valve between the centrifugal pump case and the pitcher pump. The discharge side of the centrifugal pump was fitted with a flap-type check valve and supplementary gate valve.



Kitchen pump mounted on centrifugal unit solves priming problem.

With the suction hose submerged a small pail of bailed water was enough to prime the pitcher pump, which was then used to fill both the suction hose and centrifugal unit. The globe valve beneath the pitcher pump was then closed and power applied to the centrifugal unit.

Notes on Sewage Disposal

A monthly summary of current developments conducted by Willem Rudolfs

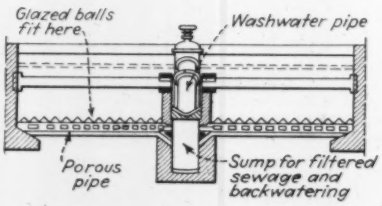
SEWER VENTILATION—Theories of sewer ventilation have been undergoing considerable modification. For instance, ventilation has been considered advisable to prevent nuisances and corrosion, minimize collection of gases liable to endanger men working, and to remove explosive mixtures. It has been assumed that sewer gases would tend to rise, run up the gradients of the sewers and be discharged at high points. Others have held that the flow of sewage would carry the gas with it by friction.

Now it is reported that these causes of air flow are of little importance. But the surging action caused by the filling and emptying of sewers as a result of the different rates of flow has a marked effect on ventilation. Escritt (*The Surveyor*, June 23, 1939) states that by far the most important ventilating agent is the difference of barometric pressures at the various parts of the sewerage system, in other words, wind action. The flow of air in the sewers will be in the same direction as the wind and often more marked than on the surface. He believes that in the design of sewerage systems arrangements for ventilation should be made so as to take full advantage of the effects of differences of barometric pressure in the different parts of the area drained. In the case of an empty 12-in. sewer, 1,000 ft. long, a difference of air pressure of 0.001 lb. per sq. in. produces an air flow of nearly 100 cu. ft. per minute through the sewer.

SEWER CORROSION—Corrosion and disintegration of concrete sewers by hydrogen sulphide formed biologically from organic matter retained at low or flat places in the sewers find frequent demonstration. Activities of sulphur-reducing organisms present in the slime adhering to the walls of the sewers are stimulated by increased temperatures. The type of cement used appears also to be of consequence because of the presence of so-called "free" lime. Cement may contain from 5 to 7 per cent free lime, which is assumed to react directly with the sulphates present in the sewage or groundwater. Holroyd (*The Surveyor*, June 30, 1939) believes that the sulphates would also react with certain hydrated calcium aluminates present in the cement concrete to give a calcium sulpho-aluminate. Both reactions lead to expansion and disintegration of the concrete. He concludes from experience and analyses that if sulphates are below 30 ppm as sulphur trioxide in the groundwater or sewage, corrosion was unlikely, but where corrosion had occurred 50 ppm or over were generally found.

The density of the concrete influences the rate of corrosion, and the possibility that corrosion might be due to high concentrations of sulphates (such as occur in nodules of gypsum), makes the attachment of definite figures to the safety limit most difficult. It is probable that the effective concentrations of sulphates may be different under various conditions and not the same as that which is found in sewage or water recovered from test holes.

SEWAGE FILTERS—The impossibility of treating sewage by the activated sludge process or of removing sufficient sludge from the chemically-treated sewage, together with the requirement for a higher type of treatment than that afforded by efficient settling, led Mahr (*Die Stadterreinigung*, June, 1939) to construct a series of 10 filters, 300 square meters each, with sand supported by triangular cement ribs and provided with backwashing facilities. The slots between the cement ribs are 1 cm. wide at the bottom and are covered with unglazed porcelain balls to hold the sand. Backwashing is accomplished with air and effluent; filter runs are about 16 hrs., and the washwater requirement about 8 per cent. (See sketch.)



Sewage sand filter fitted with ball bottom for backwashing.

TEMPERATURE AND WASTE TREATMENT—Some trade wastes are discharged at a rather high temperature. Couple this with the fact that various biological treatment processes produce better results in summer than in winter with equivalent loadings. This casts light on the investigation made by the Water Pollution Research Board of England (1938 *Report*) on the effect of temperature on the purification of milk wastes using the activated sludge process.

It was shown that with crude liquid of about 800 ppm B.O.D. the best results were obtained when the temperature was about 85 deg. F. and that only slightly less effective results were obtained at 70 deg. F.; effluents of 4 and 9 ppm respectively were obtained after settling. Special interest attaches to the finding that fat destruction was much greater at the higher temperature; namely, only 1.4 per cent as against 9.1 per cent fat in the dry sludge. This is of importance when the sludge is used as a fertilizer. The total nitrogen in the dry sludge was over 8 per cent.

SELLING SLUDGE—Twelve thousand tons of Milorganite, product of the Milwaukee disposal plant, have been sold during the first five months this year, according to V. H. Kadish, sales manager for the Milwaukee Sewerage Commission. This is 25 per cent greater than last year and, if it keeps up at the present rate, will mean that the city will be able to dispose of about 46 per cent of the plant's production for the year. This fertilizer, first produced in 1927, is being sold in about thirty states and Canada at present. When it is considered that the average golf course uses from 25 to 50 tons of this particular type of fertilizer, some idea of the possibilities for the sale of the product can be seen.

FLEXIBILITY · · · TOUGHNESS · · · DURABILITY

· · · STRENGTH · · · ELASTICITY · · ·

Archimedes took no chances

with his self-made block and tackle when he offered "To do the work of a hundred men" with it . . . because he had designed and constructed his equipment with a definite purpose . . . he had tested its ability, and consequently was sure what the results would be.

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A MATTER OF CHANCE

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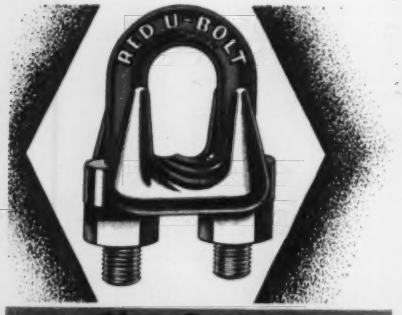

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CROSBY CLIP

Has been the standard of safety for wire rope fastenings since 1883—It is designed for greatest grip and drop forged from special analysis steel. Hot galvanized. Easy to put on; readily inspected. Cheapest because safest.

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High In Capacity And
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LOCK JOINT
Reinforced Concrete
PRESSURE PIPE

LOCK JOINT PIPE COMPANY
AMPERE, N. J.

ABSTRACTS AND NOTES

Highway Transport Of 54-ton Loads

A 12-mile road called the "Highway to the Stars," built specially for transporting the large and heavy parts of the great telescope on Mount Palomar, in California, rises from Rincon, El. 2,670, to the observatory plateau, El. 5,568, by grades not exceeding 8 per cent and curves of 100 ft. minimum radius. Its roadway, with oil-treated surface, is 28 ft. wide. The total distance from San Diego, where the telescope parts are delivered by steamers, is 75 miles. As described by Walter Beuthel, assistant district highway engineer, in "California Highways and Public Works" (bulletin of the State Division of Highways), the moving parts of the telescope weigh 425 tons, and the California Institute of Technology referred the problem of transportation to the State Division of Highways. After consideration of routes and bridge conditions the telescope design was so made that the heaviest parts weighed 54 tons and the largest part was 22 ft. in diameter and 14 ft. high.

The route selected included ten bridges, all of recent construction. Factors considered were absence of weak bridges, adequate width of roadbed, and favorable traffic conditions. The final new 12-mile stretch has the steepest grades but no large bridges. A large four-axle, low-bed trailer carried the largest parts, and with two trucks pulling and a third pushing on grades the trip was made in two days with each load. The State bridge department designated the definite lanes to be used on certain bridges, limited the speed, prohibited other loads on the bridge at the same time, and checked the stresses as the loads crossed.

Willows Prevent Canal Erosion

Planting willows on the bank slopes of irrigation canals to prevent erosion is described in the August issue of the "Reclamation Era" (bulletin of the U. S. Reclamation Bureau). The species used for this purpose must not be confused with the so-called water-willows which grow in canals and drainage ditches and become serious obstructions to flow. The brittle-willow is recommended, as its fine roots come to the surface and form a protective mat.

Along the Pathfinder canal of the North Platte irrigation project there are 20 miles lined with these trees, which have been grown from cuttings. This section of the canal lies in the sand hills, and has a flow velocity as great as 5 ft. per second, but no erosion occurs where the root mats cover the slopes. Cuttings for planting are 7 to 10 in. long, each containing two or more buds; they are made preferably in January or February and are put up in bundles of 50 or 100. The cuttings are planted when the ground is soft enough to allow of pushing them vertically into the bank without skinning or peeling them, and they are set with not more than 2 in. of the length above ground. They are set three or four inches above the water line, and spaced approximately 6 ft. apart. For mature willows, a spacing of 12 to 18 ft. is sufficient to insure covering of the slopes by the roots.

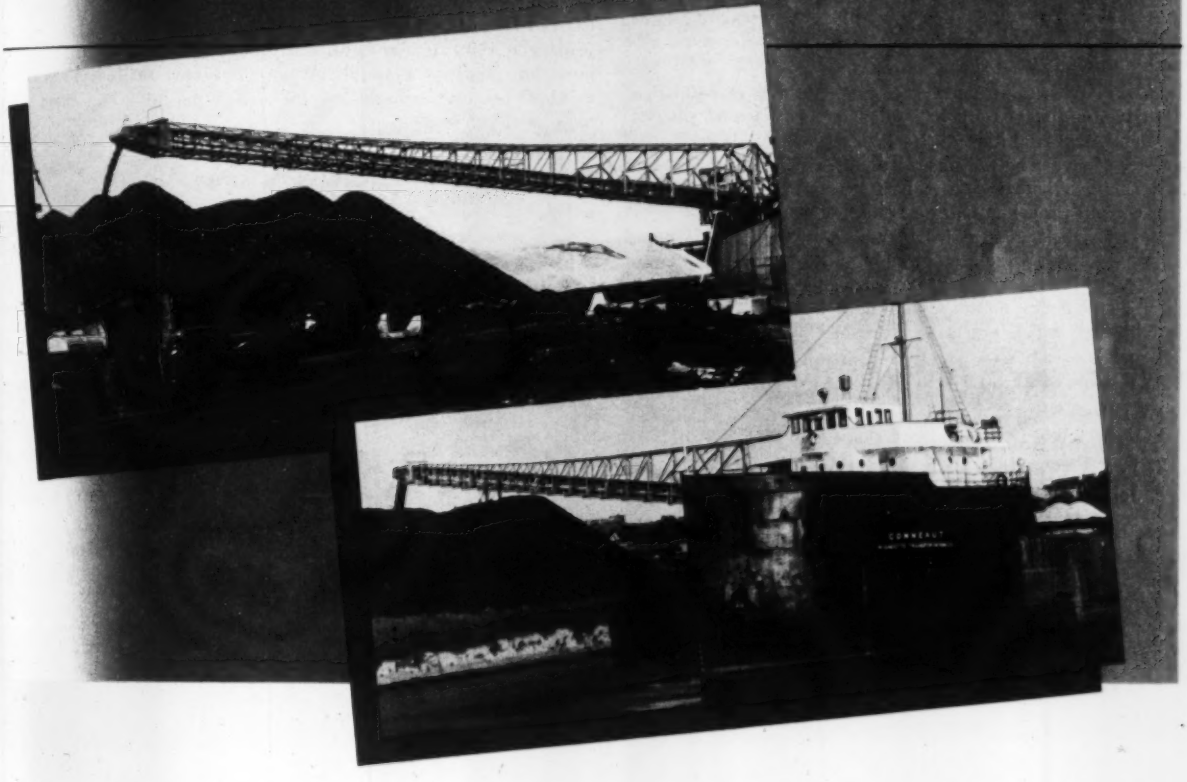
Apprenticeship Study Urged for Construction

Careful study of successful apprenticeship practices is recommended as a basis for apprenticeship standards for the construction industry by the sub-committee on standards of the Federal Committee on Apprenticeship in a report submitted in Washington.

The report states that the industry has had a number of excellent systems in many parts of the country—systems which should be given careful attention. The subcommittee recognizes a need for enlisting cooperation throughout the industry, a need for coordinating systems already in operation, and a need for assuring year-around apprentice employment.

Recommendations are as follows: that national standards be established by the construction trades; that national apprenticeship standards for a given trade be supported by adoption of similar state-wide standards; that facts supporting need for sound standards be placed before each state legislature.

ALUMINUM MADE POSSIBLE A 55% longer reach WITH THIS UNLOADING BOOM



Lightweight Alcoa Aluminum shapes and plate were used for the outer 190 feet of the new boom on the self-unloading ship S. S. Conneaut owned by the Wyandotte Transportation Company. This permitted the new boom to be made 68 feet longer than the old, giving it a 55% increase in effective outboard reach.

The lighter weight of this boom makes it easier to trim the ship during unloading operations. Less burden is placed on the ship's framing and on the boom-handling machinery. Stowed, and with the boat underway, this lighter superstructure improves the stability of the vessel.

Regular shop equipment and personnel were used by Whitehead & Kales Company of Detroit in fabricating this boom. Assembly, completed by the Michigan Alkali Company, was expedited by the light weight of the Aluminum sections and parts. ALUMINUM COMPANY OF AMERICA, 2108 Gulf Building, Pittsburgh, Pennsylvania.

ALCOA ALUMINUM

CONTRACT UNIT PRICES

What contractors are bidding on different kinds of construction work

LOYALHANNA DAM PENNSYLVANIA

OWNER: U. S. Engineer Office, Pittsburgh, Pa.; Lt. Col. W. E. R. Covell, district engineer.

PROJECT: Construction of Loyalhanna Dam on Loyalhanna Creek approximately 2½ miles south of Saltsburg, Pa. Includes unwatering and removing of cofferdams; clearing dam site and excavation for dam and appurtenant structures; concrete gravity-type dam complete, including training walls, stilling basin and generator room; earth embankment; and installing equipment furnished by Government.

CONDITIONS: Contractor must complete dam in 840 calendar days, and start work in 10 days after notice to proceed. Rail and improved highway facilities available. Wage rates: skilled, $1.40 per hr.; semi-skilled, 90c. per hr.; and common, 70c. per hr. All materials to be furnished by contractor, except cement for concrete, grout and mortar; embedded metal for crest gates; slide gates including hydraulic hoists and slide gate conduit liners; deflector plates and low discharge sluice liner; needle and gate valve, and accessories; water supply and sump pumps; and main auxiliary distribution switchboard, which are to be furnished by owner.

BIDS: Seven bids were received September 7, 1939, ranging from the low of $1,371,710 to $1,802,561.

LOW BIDDERS:

1. Great Lakes Dredge & Dock Co., Chicago, Ill. $1,371,710
2. F. J. Fitzgerald Constr. Co., Boston, Mass.. 1,458,631
3. John F. Casey, Aspinwall, Pa..... 1,552,000

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Cofferdams	L.S.	$80,000.00	$136,293.00	$50,000.00
2. Clearing and grubbing	L.S.	1,950.00	10,000.00	10,000.00
3. Stripping	3,100 c. y.	.65	1.00	1.00
4. Common excavation	47,000 c. y.	.65	1.50	1.00
5. Rock excavation	47,000 c. y.	2.50	2.25	2.85
6. Rock excav., trenches	110 c. y.	10.00	10.00	10.00
7. Special rock excav	5,700 c. y.	2.60	8.00	5.00
8. Line drilling	16,000 s. f.	.65	1.00	.60
9. Rock treatment (1 coat)	200 sq.	1.80	3.00	3.50
10. Furn., inst., vitr. tile	L.S.	65.00	400.00	176.00
11. Rolled fill, embankment	41,000 c. y.	.48	.60	.20
12. Rolling, each add'l. 3 trips	8,200 sq.	.04	.15	.04
13. Rock fill, embankment	16,500 c. y.	.45	.75	.40
14. Random fill	6,100 c. y.	.45	.20	.20
15. Place top soil	1,200 c. y.	1.00	1.10	.50
16. Seeding	1.5 ac.	130.00	400.00	150.00
17. Rock paving	320 s. y.	3.00	4.00	5.00
18. Drill 2-in. grout holes (percus.)	800 l. f.	.75	1.00	1.00
19. Drill 2-in. grout hole (core)	1,500 l. f.	1.80	2.00	1.60
20. Drill 3-in holes, rock	3,700 l. f.	1.20	1.25	1.25
21. Drill 6-in. core holes	200 l. f.	8.00	6.00	6.50
22. Haul and store cement	113,000 bbl.	.10	.10	.10
23. Reinforcing steel	530,000 lb.	.045	.04	.06
24. Pressure grouting	4,500 sack, cmt.	1.50	1.00	1.50
25. Class A concrete	2,600 c. y.	23.00	16.00	25.00
26. Class B concrete	44,000 c. y.	7.55	8.20	7.95
27. Class C concrete	65,000 c. y.	7.55	6.42	7.95
28. Filter	3,900 c. y.	.75	4.00	.50
29. Road surfacing	4,200 s. y.	2.00	1.10	1.50
30. Install equip. furn. by gov't	725,000 lb.	.02	.03	.03
31. Fur. & inst. spillway serv. brdg	L.S.	24,500.00	25,000.00	22,000.00
32. Structural steel	119,000 lb.	.09	.06	.09
33. Misc. metal work	64,000 lb.	.15	.15	.25
34. Corr. met. pipe	34,000 lb.	.20	.25	.25
35. Wrought iron pipe	5,100 lb.	.20	.20	.20
36. Black steel pipe	17,000 lb.	.13	.15	.15
37. Galv. steel pipe	7,900 lb.	.15	.22	.40
38. Cast iron pipe	300 lb.	.20	.12	.25
39. Iron castings (spec. analysis)	93,000 lb.	.266	.20	.25
40. Misc. brass and bronze	990 lb.	1.00	.60	1.00
41. Gantry crane rail	39,000 lb.	.07	.10	.10
42. Plumbing system	L.S.	2,000.00	1,000.00	2,500.00
43. Ornamental iron work	L.S.	260.00	3,000.00	5,000.00
44. Glass blocks	L.S.	160.00	400.00	330.00
45. Roofing	L.S.	300.00	1,000.00	800.00
46. Copper stops	7,700 lb.	.50	.40	.60
47. Steel water stops	41,000 lb.	.10	.15	.10
48. Electric wiring conduit	L.S.	9,750.00	7,500.00	7,500.00
49. Power and lighting system	L.S.	13,650.00	14,500.00	10,500.00
50. Highway guard rail	1,530 l. f.	1.30	2.00	.70

CANAL LOCK, FLORIDA

OWNER: U. S. Engineer Office, Jacksonville, Fla., Col. Lewis H. Watkins, district engineer.

PROJECT: Constructing Lock No. 1 on St. Lucie Canal about 8 miles from Stuart, Fla. To replace two obsolete locks. Concrete and steel piling construction with steel sector gates. Length 250 ft., width 50 ft.; depth over sills 11 ft. Normal lift 14 ft.

CONDITIONS: Contractor to furnish all materials and finish project in 480 calendar days. Rail, water and highway transportation facilities available. Wage rates are: skilled, $1.00 to $1.50 per hr.; semi-skilled, 50 to 80c. per hr.; and common, 40c. per hr.

BIDS: Thirteen bids were received July 27, 1939, ranging from the contract low of $642,766 to $1,029,871.

LOW BIDDERS:

1. Cleary Bros. Constr. Co., W. Palm Beach, Fla. $642,766
2. Spadaro Contracting Co., Sarasota, Fla..... 657,762
3. Hardaway Contracting Co., Columbus, Ga... 665,463

Item	Quan.	Unit Prices (1)	(2)	(3)
1. Clearing	L.S.	$5,500.00	$3,500.00	$500.00
2. Cofferdam (work included)	675 l. f.	50.00	34.00	50.00
3. Structural excavation	99,892 c. y.	.30	.75	.40
4. Channel excavation	115,404 c. y.	.20	.15	.15
5. Fill	82,997 c. y.	.15	.05	.10
6. Wood piling, untr	58,250 l. f.	.35	.50	.40
7. Wood piling, creosoted	5,170 l. f.	1.05	1.50	1.00
8. Steel sheet piling, cutoff walls	26,264 s. f.	1.15	1.40	1.00
9. Steel sheet piling, Lockchamber walls	17,955 s. f.	3.16	2.50	2.50
10. Same, Anchor walls, 32#	9,939 s. f.	1.52	2.00	1.20
11. Same, Anchor walls, 27#	140 s. f.	1.20	2.00	1.10
12. Same, connecting walls	7,755 s. f.	1.50	2.00	1.40
13. Timber fenders, creosoted	35.71 M bm.	125.00	250.00	110.00
14. Timber framing, creosoted	6.73 M bm.	110.00	250.00	110.00
15. Timber, white oak sills	1.80 M bm.	150.00	250.00	300.00
16. ¼-in. galv. wire strand	2,464 l. f.	.12	.30	.10
17. Class A conc	368 c. y.	20.00	27.00	22.00
18. Class B conc	13,078 c. y.	13.75	15.00	20.00
19. Slushing concrete	669 c. y.	12.50	17.00	22.00
20. Struct. steel, class 1	411,584 lb.	.11	.08	.11
21. Struct. steel, class 2	42,821 lb.	.10	.07	.08
22. Struct. steel, class 3	70,420 lb.	.10	.08	.09
23. Struct. steel, class 4	119,714 lb.	.07	.05	.054
24. Steel tie rods, nuts, turnbuck	111,564 lb.	.10	.05	.076
25. Corrosion resist. steel	1,444 lb.	.534	.62	.42
26. Conc. reinf. steel	149,426 lb.	.045	.05	.04
27. Steel castings	23,950 lb.	.216	.16	.18
28. Iron castings	4,492 lb.	.212	.10	.17
29. Steel forgings	31,438 lb.	.11	.25	.09
30. Nickel steel forgings	6,534 lb.	.40	.27	.33
31. Bronze	996 lb.	.80	.75	.80
32. Wire mesh guard screen, frames	L.S.	710.00	700.00	700.00
33. Copper sealing strip	1,381 l. f.	.53	1.00	.70
34. 6-in. steel pipe, black	93 l. f.	4.85	4.00	5.00
35. 2-in. galv. pipe, handrail	1,027 l. f.	2.75	2.00	1.80
36. 1½-in. galv. pipe, handrail	619 l. f.	2.50	2.00	1.50
37. Gate operat. rack, cast stl	4 ea.	1,320.00	600.00	1,400.00
38. Gate lubric. system (4 gates)	L.S.	105.00	40.00	100.00
39. Rubber seals, bumpers; molded	1,338 lb.	1.00	1.10	1.00
40. Float gauge well assembly	L.S.	200.00	200.00	400.00
41. Staff gauge, frame assembly	L.S.	300.00	300.00	200.00
42. Conduit, fibre, 3-in. dia	1,670 l. f.	.58	.40	.50
43. Conduit, fibre, 2-in	1,760 l. f.	.53	.30	.45
44. Rigid metal conduit, 2-in	150 l. f.	.14	.50	1.20
45. Stone protection, native rock	4,381 c. y.	4.00	3.00	3.00
46. Crushed stone	1,563 c. y.	3.25	5.00	3.00
47. 10-in. corr. met. pipe	1,231 l. f.	1.37	.60	1.00
48. 12-in. corr. met. pipe	330 l. f.	2.06	.75	1.60
49. 15-in. corr. met. pipe	44 l. f.	2.35	1.00	2.00
50. 24-in. corr. met. pipe	150 l. f.	3.50	1.25	3.00
51. Excav., drainage ditch	2,000 c. y.	.24	.50	.40
52. Remove concrete	30 c. y.	15.00	5.00	3.00
53. 1½-in. dowel holes	105 l. f.	.50	1.00	.50
54. Lock attendants quarters, 5 bldgs	L.S.	40,997.00	25,000.00	21,000.00
55. Machinery houses	4 ea.	861.74	800.00	400.00
56. Water supply system	L.S.	4,560.00	3,600.00	2,400.00
57. Sewerage system	L.S.	2,575.00	1,650.00	1,100.00
58. Macadam road	3,360 s. y.	1.30	1.25	1.00
59. Rein. conc. sidewalk	167 s. y.	2.85	3.00	1.50
60. Move tender's house and facilities	L.S.	1,500.00	1,800.00	300.00
61. Pressure relief valve assy	L.S	500.00	500.00	400.00

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has what it takes

JUDGE a ball-player by his batting average—a Portland cement by its performance record. Typical of 'Incor's long-time, expense-free service is this loading dock at Mutual Ice & Cold Storage plant, Topeka, Kansas.

Here 'Incor' gets the roughest, toughest kind of punishment . . . steel-wheeled trucks, beer barrels and what-have-you . . . banging and bumping out of freight cars onto the concrete.

Placed in September, 1928 . . . 11 years of heavy-duty service . . . 'Incor' concrete still in first-class condition . . . not a penny for maintenance.

That is the kind of service 'Incor' is giving under hardest wear the country over, on all types of jobs, large and small.

Dependable 24-hour service strength cuts concrete costs at the outset; long-time durability saves money through the years.

Use 'Incor'* wherever faster job curing or dependable high early strength shows a net saving; elsewhere use Lone Star, quality standard ever since 1900. Write for copy of "Heavy-Duty Floors." Lone Star Cement Corporation, Room 2282, 342 Madison Avenue, New York.

*Reg. U. S. Pat. Off.

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LONE STAR CEMENT CORPORATION

MAKERS OF LONE STAR CEMENT • • • 'INCOR' 24-HOUR CEMENT

MATERIALS AND LABOR PRICES

Market quotations on construction materials and wage rates reported monthly by ENR correspondents

OCTOBER lumber prices are more active than at any time during the year as a result of increases in 12 of the 20 cities over the preceding month. Pine is up $6.50 to $9.25 in Cincinnati; $3.50 to $10.50 in Baltimore; $2.00 to $8.00 in Boston; $2.00 to $7.00 in Birmingham; $3.00 in Minneapolis; $2.00 to $3.00 in St. Louis; $2.00 in Atlanta, Cleveland and New York; $1.00 to $1.50 in Kansas City; and $1.00 on the 1x6-in. size in Chicago.* Douglas Fir prices advanced in Baltimore, Boston, Chicago, Kansas City, Minneapolis, New York and Seattle.

Form grade Douglas Fir plywood prices are unchanged from a month ago, but many manufacturers are out of the market and will not take future orders until labor and log prices settle, probably sometime after the first of the year.

Cement, aggregates and ready-mixed concrete prices remain at last month's levels.

Iron and steel product base prices have been reaffirmed for the fourth quarter, but many mills are out of the market for sheet and strip, having exhausted their capacities for the balance of the year. Prices for the first 1940 quarter are expected to be announced in about two weeks. High scrap iron and steel prices have cut the 15c. differential that existed between new billet and rail steel reinforcing bars to 10c. in eleven of the 20 cities. Cast iron pipe is up $3.00 per ton in all 20 cities.

Dry red lead is up 25c. per 100 lb. and white lead in oil is 50c. per 100 lb. higher throughout the nation.

Labor rates, both skilled and common, are unchanged from last month.

CEMENT, AGGREGATES, READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT — Per bbl., carload lots, including 40c per bbl. for bags, cash discount not included			SAND AND GRAVEL — Per ton, carload lots			CRUSHED STONE — Per ton, carload lots		CRUSHED SLAG — Per ton, carload lots, f.o.b. plant		CONCRETE Ready Mixed 1:2:4, 50 c.y. or more, delivered
	Cloth Bags	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	
Atlanta	$2.90	$2.65	$2.60	$1.75	$1.85	$1.95	$1.65	$1.75	$1.55	$1.65	$7.90
Baltimore	2.31	2.06	1.86	1.75‡	1.75‡	1.25‡	1.75‡	1.75‡	1.75‡	1.75‡	6.50
Birmingham	2.50	2.25	2.05	1.80	1.80	1.45	1.00	1.00	.90	1.15	5.45
Boston	2.75*b*	2.50*b*	2.30	1.10‡	1.10‡	.80‡	1.10‡	1.10‡	....	....	6.75*m*
Chicago	2.75	2.50	2.35	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	2.15‡*d*	1.25‡	1.25‡	....
Cincinnati	2.58	2.33	2.08	1.20	1.20	1.10	1.80	1.80	....	....	6.60
Cleveland	2.29	2.04	....	1.45*i*	1.45*i*	1.45*i*	1.60*i*	1.60*i*	1.70*i*	1.70*i*	6.85*i*
Dallas	2.30	2.05	1.85	2.00*p*	2.00*p*	1.50*p*	1.69*p*	1.84*p*	....	....	6.20
Denver	3.02	2.77	....	1.20	1.40	.90	....	....	....	....	7.25
Detroit	2.15	1.90	1.70	1.30	1.40	.81	1.45	1.45	1.14‡	1.14‡	6.50
Kansas City	2.56	2.31	2.16	1.85	2.30	1.00	1.91	1.91	....	....	7.90*n*
Los Angeles	2.82*b*	2.62*b*	....	1.00	1.00	1.00	1.00*f*	1.00*f*	....	....	5.85
Minneapolis	3.00	2.75	....	1.00*h*	1.00*h*	.25*h*	1.00*h*	1.00*h*	....	....	7.35*j*
Montreal	....	....	1.48	....	....	1.25‡	.90‡*c*	1.00‡*c*	....	....	7.60*l*
New Orleans	2.41	2.16	1.96	1.50	1.50	1.25	....	....	....	....	7.25
New York	2.60‡	2.35‡	....	1.40*de*	1.40*de*	.90*de*	1.65*de*	1.75*de*	....	....	7.25
Philadelphia	2.32	2.07	1.87	1.55‡	1.65‡	1.25‡	....	....	1.00	1.00	7.95*k*
Pittsburgh	2.44	2.19	1.99	1.80‡	1.80‡	2.10‡	2.25‡	2.25‡	1.50	1.50	8.75
St. Louis	2.55	2.30	....	1.50‡	1.50‡	1.25/1.50‡	.85*h*	.85*h*	.75*g*	.75*g*	7.50
San Francisco	2.72	2.52	2.20	1.36	1.36	1.36	1.46	1.46	....	....	7.63
Seattle	2.95*o*	2.70*o*	....	1.00*o*	1.00*o*	1.00*o*	2.00*o*	2.00*o*	....	....	7.50*o*

‡ Delivered. *a* 10c. allowed for each returnable bag. *b* 10c. per bbl. off for cash. *c* Plus municipal tax. *d* Per cu. yd. *e* Barge lots alongside docks *f* Crushed granite. *g* F.o.b. Granite City, Ill. *h* F.o.b. plant. *i* Within three miles of Public Square. *j* 5% discount for cash. *k* Discount 35c. 500 to 2000; 70c. 2000 to 5000; 95c. over 5000. *l* Up to 200 cu. yd. *m* 50c. off for cash. *n* 25 c.y. or more. *o* 2% off for cash. *p* 10c. per ton off, cash 15 days

CASH DISCOUNTS CEMENT to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount 10c. per bbl. for payment within 15 days of date of invoice, in Montreal 5% if payment before 15th.

CURRENT MAXIMUM PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Buffington, Ind	$1.70	$1.65	Ironton, Ohio	$1.60	$1.55	Richard City, Tenn	$1.80	$1.75
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind	1.70	1.65	Steelton, Minn	1.80	1.75
Hannibal, Mo	1.70	1.65	Norfolk, Va	1.65	1.60	Universal, Pa	1.65	1.60
Hudson, N. Y	1.75	1.70	Northampton, Pa	1.55	1.50	Waco, Tex. (Plus 5c. Tax in Texas)	1.75	1.70
Independence, Kans	1.70	1.65	North Birmingham, Ala	1.70	1.65			

PAVING BRICK, BLOCKS, ASPHALT, ROAD OILS—F.O.B. CITY

	PAVING BRICKS AND BLOCKS — Granite per M. lots of 50,000 4x4x8 in.	Brick per M. 3x4x8½ in. carload lots	Wood per sq. yd. 3½ in. 16-lb. treat	PAVING ASPHALT — Per ton, less than 80 penetration Tank car	Drums	ASPHALT BINDERS — FLUXES — Per gal. 80-300 penetration Tank car	Drums	CUTBACK ASPHALT — Per ton Tank car	Drums	ROAD OILS — Per gal. Tank car	ASPHALT EMULSION (Quick-breaking) Per gal. Tank car	Drums
Atlanta	$75.00	$39.35	$2.25	$16.60*e*	$21.80*e*	$0.0645*e*	$0.0945*e*	$0.0684*he*	$0.0984*he*	$0.0584*e*	$0.0684	$0.0684
Baltimore	140.00‡	44.00‡	2.50	12.00	17.00	.045	.07	.055*h*	.125	.....	.....	.....
Birmingham	.....	24.50*j*	.....	18.20	23.20	.0747	.1047	.0834*h*	.1484*h*	.....	.....	.....
Boston	80.00	47.00	3.25	13.00	18.00	.05	.08	.06*h*	.125	.....	.09‡	.12‡
Chicago	150.00	52.00	1.80*d*	14.00	18.00	13.00*g*	17.00*g*	.055	.105	.0275	.08	.12
Cincinnati	112.00	37.50	.....	14.31	18.31	.10	.....	18.00	.....	.0525	.....	.08
Cleveland	110.00	37.25	2.80	15.25	20.50	.07	.08	.07*h*	.085*h*	.035	.08	.09
Dallas	.....	30.00	.....	12.00	17.00	.04	.07	13.00	18.00	.035	.05/.07	.07/.09
Denver	.....	27.50	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
Detroit	.....	35.00	.....	13.60*f*	18.00*f*	.0593	.0994	13.60	18.00	.0535	.0567	.0924
Kansas City	.....	44.00	.....	18.50	23.50	.077	.1075	.077*h*	.107*h*	.057	.11	.15
Los Angeles	.....	50.00	.....	6.50*b*	15.00	6.50*b*	15.00*g*	5.50*b*	.....	.0192	.0525	.1125
Minneapolis	.....	.....	1.90*d*	19.20	24.20	.10	.12	19.30	28.30	.056	.....	.....
Montreal	82.00	.....	3.62	14.60	21.25	.105	.1375	.101*h*	.121*h*	.0935	.13	.16
New Orleans	.....	.....	.....	14.00*a*	19.00*a*	.055	.085	.06*h*	.09*h*	.....	.078	.....
New York	.....	68.00	2.70	12.50	17.50	.05	.075	.055*h*	.125*h*	.....	.07	.10
Philadelphia	120.00	42.50	2.84	14.00	19.00	.055	.08	.06*h*	.09*h*	.05	.06	.09
Pittsburgh	115.00	40.00	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
St. Louis	110.00/121.00	37.00	.....	14.00	19.00	.055	.085	.06*h*	.09*h*	.035	.08	.12
San Francisco	.....	70.00	.....	6.50	15.00	6.50*g*	15.00*g*	7.00	17.50	.025	.0475	.117
Seattle	.....	60.00*c*	.....	13.75	23.55	.....	25.15*g*	10.15/11.15	23.65/24.65	8.40*g*	.0575*i*	.1308*i*

‡ Delivered. *a* F.o.b. Baton Rouge. *b* Delivered to purchaser's warehouse. *c* 3½x4x8½ in. *d* 2½ in. 6 to 8-lb. treatment. *e* Local reduction due to 20% reduction intra-state class freight rates, only Georgia affected. *f* Mexican. *g* Per ton. *h* Per gallon. *i* F.o.b. Martinez. *j* 3x3⅝x8½ in.

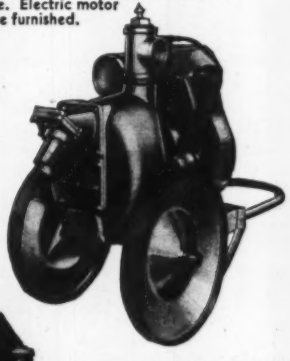
(Continued on page 88)

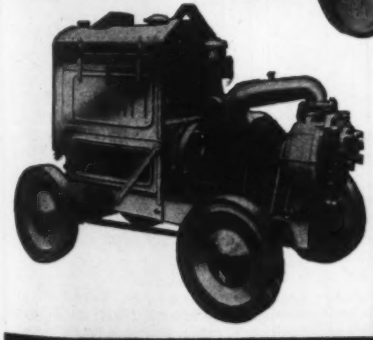
WORLD'S CHAMPION PUMP

ABOVE: Model 10PH "Sure Prime", 220,000 G.P.H.

World's Champion Bantam Pump — ONLY 52 Lbs.

100% automatic priming, pumps 3000 G.P.H. at 30 ft. head. Aluminum alloy shell. $85 f.o.b. factory with ¾-1 H.P. engine. Electric motor can be furnished.





All sizes 1½" to 10" extremely compact. Up to 6" sizes on 2 wheels.

Self - Priming Dual - Purpose Jetting - De-watering Pumps: One pump does work of two.

Contractors Buy More JAEGER SURE-PRIMES than Any Other Pumps . .

because: Jaeger gave the world the modern self-priming centrifugal whose small price and huge capacity revolutionized the cost of handling water,

because: Jaeger, alone, has the high velocity "Priming Jet"—30% to 50% faster priming, 100% automatic, 100% sure to prime even at maximum lifts, even (in hi-head models) against vertical heads exceeding 100 ft.,

because: Jaeger's patented Self-Cleaning Shell, Lubri-Seal, pump mounting, shaft and impeller are a marvel of engineering design, consistently delivering ***thousands of extra hours*** of unfailing service without stop or replacement of a single part,

because: every pump Jaeger builds is individually tested for capacity and pressure before it ever leaves the factory.

Our latest Catalog P-39 describes the most complete line of pumps on the market for drainage, supply and well point work. Send for your copy and prices, today.

The Jaeger Machine Co., 200 Dublin Ave., Columbus, O.

WORLD'S LEADING MANUFACTURERS: CONCRETE MIXERS — PUMPS — HOISTS — TOWERS — TRUCK MIXERS — CONCRETE-BITUMINOUS ROAD MACHINERY

(Continued from page 86)

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet *b*	RIVETS ½-in. structural	WIRE NAILS Base *d*	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	STEEL RAILS Light	STEEL RAILS Re-rolled	TRACK SUPPLIES Angle Bars	TRACK SUPPLIES Std. Spikes *c*	TRACK SUPPLIES Tie Plates *c*	TRACK SUPPLIES Track Bolts
Birmingham...*	$2.10	$1.90	$3.40	$2.40	....	$40.00	$40.00	$39.00	$2.70	$3.00	$2.15	$4.15
Chicago.....*	2.10	1.90	3.40	2.40	$2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Pittsburgh...*	2.10	1.90	3.40	2.40	2.40	40.00	40.00	39.00	2.70	3.00	2.15	4.15
Buffalo.....*	2.10	1.90	....	....	2.40	....	....	....	....	....	2.15	....
Cleveland...*	2.10	1.90	3.40	2.40	....	....	....	....	....	....	....	....
Youngstown..*	....	1.90	....	....	....	....	....	....	....	3.00	....	....
Detroit.....*	....	2.00‡	....	....	....	....	....	....	....	....	....	....
Gulf ports....	2.45*a*	2.25*a*	....	....	2.85*a*	....	....	....	....	....	....	....
Pacific ports..	2.70*a*	2.35*a*	....	....	2.90*a*	....	....	....	....	3.00	2.25	....

‡ Delivered. *a* F.o.b. cars dock. *b* For rail steel deduct 15c. from billet prices. *c* Other basing points include Portsmouth, O., Weirton, W. Va., St. Louis, Kansas City, Minnequa, Colo., and Pacific coast ports, on tie plates alone, Steelton, Pa., on spikes alone, Lebanon, Pa., Richmond, Va. *d* Add switching charge $18 per c.l. * Base prices reaffirmed for fourth quarter; many mills taking no orders; 1940 first quarter prices expected to be announced soon.

IRON AND STEEL PRODUCTS—F.O.B. WAREHOUSE, PER 100 LB., BASE PRICE

	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS* Per 100 lb., ¾ in., base price 15 tons or over *b* New billet	Rail steel	Add Switch	$/cwt. for Del.	EXPANDED METAL LATH—Per 100 sq.yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING—Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in. No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb. base price
Atlanta.....	$2.34	$2.14	$2.04	.02½	.10	$21.00	$23.00	$1.70	$1.28	$0.1604	$3.04
Baltimore.....	3.55	2.70	2.55	.....	.10	21.00	23.00	1.58	1.20	.1496	2.70
Birmingham.....	2.10*a*	1.90	1.80	.02½	.10	19.50	21.50	1.68	1.26	.1586	....
Boston.....	4.00	2.73	2.58	$20 C.L.	.10	21.50	23.50	1.64	1.24	.1550	3.14
Chicago.....	2.10*a*	1.90	1.80	.03	.05	18.50	20.50	1.55	1.18	.1460	2.40
Cincinnati.....	3.68	2.16*c*	2.16*c*	.....	.05	20.50	22.50	1.54	1.17	.1451	....
Cleveland.....	3.58*g*	1.90	1.80	.02½	.10	20.50	22.50	1.54	1.17	.1460	....
Dallas.....	4.15	2.80	2.65	.....	.....	25.00	27.00	1.81	1.35	.1712	....
Denver.....	4.35	3.95	3.80	.....	.....	23.50	25.50	1.85	1.37	.1748	....
Detroit.....	3.65‡	2.45	2.30	.....	.10	22.50	24.50	1.56	1.19	.1478	2.66
Kansas City.....	4.03	2.51*c*	2.36*c*	.0	.05	18.50	20.50	1.66	1.25	.1577	2.86
Los Angeles.....	3.65*f*	2.65	2.50	.02½	.05	23.00	27.50	1.81	1.35	.1712	3.65
Minneapolis.....	3.80‡	2.23*c*	2.13*c*	.0	.10	21.50	24.50	1.68	1.26	.1586	2.73*f*
Montreal.....	3.25	2.65	2.55	.....	.....	26.68	29.90	2.99	2.08	.314	3.95
New Orleans.....	3.90	2.27	2.12	.05	.10	21.50	23.50	1.71	1.29	.1522	2.875
New York.....	3.75	2.39	2.29	.....	.10	20.50	22.50	1.64	1.24	.1557	2.74
Philadelphia.....	3.55	2.66	2.56	.....	.....	19.50	21.50	1.59	1.21	.1505	2.72
Pittsburgh.....	2.10*a*	1.90	1.80	.02½	.10	21.50	24.50	1.47	1.13	.1388	2.40
St. Louis.....	3.47	2.14	2.04	.0	.05	20.50	24.00	1.57	1.19	.1487	2.70
San Francisco....	4.00	2.50	2.35	.02½	.10	23.50	25.50	1.81	1.35	.1712	3.25
Seattle.....	2.70*e*	2.40*e*	.....	.....	.....	25.50	27.50	1.81	1.35	.1712	2.90*e*

‡ Delivered. *a* Mill prices. *b* 5–15 tons, add 15c. 1–5 tons, add 25c. Less than 1 ton, add 50c. *c* 20 tons or over Base. *d* Mill price plus freight. *e* F.o.b. dock. *f* Includes delivery in free delivery zone. *g* Less than 1 ton, add 30c.; 1 to 5 tons, add 10c. * High scrap steel prices cut former 15c.; differences between new billet and rail steel in many mills.

PLUMBING, HEATING, WATER, SEWER AND DRAIN PIPE

	C. I. PIPE Per net ton f.o.b. 6 in. to 24 in.*a*	VITRIFIED SEWER PIPE Per foot, 8 in., s.s.	delivered 12 in., s.s.	ASTM 24 in., d.s.	C13–35 36 in., d.s.	CLAY DRAIN TILE * Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	CONCRETE SEWER PIPE Per ft., delivered: ASTM C 14–35 12 in.	24 in.	WROUGHT STEEL PIPE Full standard weight, *h* 1 to 3 in., Butt Weld Black %	Galv. %	3½ to 6 in., Lap Weld Black %	Galv. %
Atlanta.....	$49.40	$0.26*bc*	$0.4688*bc*	$1.8525	$4.68*c*	$85.00	$128.00	$0.45	$1.625	62.2	54.2	59.7	51.2
Baltimore.....	52.80	.30	.55	2.30	6.80	110.00	150.00	.40	1.60	65.5	57.5	63.0	54.5
Birmingham....	45.00	.25	.45	1.625	4.66	85.00	220.00	.40	1.60	62.2	54.2	59.7	51.2
Boston.....	55.00	.294	.567	2.16	6.15	199.00‡	288.00‡	.50	2.50	64.1	56.1	61.6	53.1
Chicago.....	53.80	.28	.54	2.25	6.25	100.00‡	150.00‡	.38	1.48	67.0	59.0	63.5	55.0
Cincinnati.....	52.70	.259	.4995	1.935	5.6375	75.00	120.00	.60	1.90	65.9	57.9	63.4	54.9
Cleveland.....	54.24	.224	.432	1.665	5.0225	69.00	108.00	.35	1.50	67.8	59.8	65.3	56.8
Dallas.....	58.20	.265	.477	1.728	4.70	80.00	100.00	.46	1.57	59.9	51.9	57.3	48.3
Denver.....	60.60	.24†	.52†	2.16†	.....	130.00	240.00	.....	.....	58.4	50.4	55.7	47.2
Detroit.....	54.24	.147	.2835	1.215	4.70	66.45	111.40	.162	1.125	66.3	58.3	63.8	55.3
Kansas City....	55.12	.30	.54	2.16	5.00	120.00	240.00	.45	1.60	62.9	54.9	60.0	51.5
Los Angeles....	55.00	.282†	.508†	2.034†	5.085†	115.50	192.50	1.00	2.00	56.8	47.8	54.3	44.8
Minneapolis....	57.20	.24†	.432†	1.728†	4.60†	.....	.....	.70	1.80	64.2	56.2	60.7	52.2
Montreal.....	60.00	.59	.90	3.15	5.10*e*	135.00‡	260.00‡	.48	1.92	.....	.....	.....	.....
New Orleans...	51.38	.26	.48	1.69	.....	150.00	220.00	.37	2.10	62.4	54.4	58.8	50.3
New York.....	52.20	.32	.63	2.52	6.45	.....	.....	.50	1.20	64.9	56.8	62.4	53.9
Philadelphia....	50.90	.21	.405	1.75	5.05	100.00	160.00	.54	1.80	65.3	57.3	62.8	54.3
Pittsburgh.....	55.60	.245†	.4725†	1.845†	5.4325	97.80	154.20	.85*g*	2.00*g*	68.5*i*	60.5*i*	66.0*i*	57.5*i*
St. Louis.....	52.48	.26	.504	2.016	3.96	87.00	160.00	.80*j*	2.00*k*	65.1	57.1	62.0	53.5
San Francisco..	55.00	.3275*d*	.5895*d*	2.358	5.895	107.25	178.75	.45	2.50	.....	.....	.....	.....
Seattle.....	55.35	.35	.63	2.52	6.30	72.00	175.00	.45*f*	1.40*f*	.....	.....	.....	.....

‡ Delivered. † F.o.b. *a* B. & S. class B and heavier, C/L lots, 200 tons and over Burlington, N. J. (base) $49.00. Gas pipe and class A, $3 per ton additional, 4 in., $3 per ton additional, 30 in. and larger usually $2 per ton less. *b* Double strength. *c* List to dealer. *d* List. *e* 30-inch. *f* Less 5% for cash. *g* Culvert pipe. *h* Discounts from standard list consumers carload prices, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ¾ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92. *i* Applies also at Lorain, Ohio, mills. Chicago delivered base is 2½ points less Freight is figured from Pittsburgh, Lorain, O., Chicago Dist. Billing is from point producing lowest price at destination. WROUGHT IRON PIPE: Base price and list prices per ft. same as wrought steel pipe. Discount for Pittsburgh base: Butt-weld — 1 in. and 1¼ in. black 24, galv. 19; 1½ in. black 38, galv. 21½; 2 in. black 37½, galv. 21. Lapweld — 2½ in. to 3½ in. black 31½, galv. 17½ in.; 4½ in. to 8 in. black, 32½ galv. 20. *j* Reinforced; spec. C 76-37. *k* Reinforced; spec. C 75-37.

(Continued on page 90)

For Digging Value

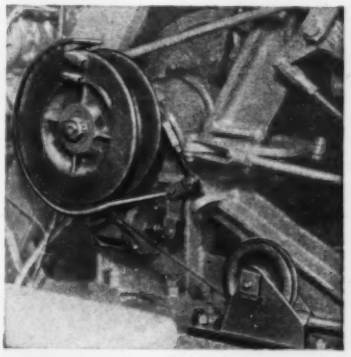
"LOOK INSIDE THE CAB"

ALL BAY CITY machines from ⅜ to 1¼ yards with crane capacities up to 20 tons follow the same proven basic design, and are carefully engineered to give biggest digging value. Look inside the cab—note the sturdy, simple, compact construction that delivers greatest power to the working end—where power counts in added yardage. A few of the outstanding BAY CITY advantages are listed on this page. Look them over, then write for attractive 32-page illustrated Catalog H-1. No obligation to learn more about these fast, powerful, easy-to-operate machines.

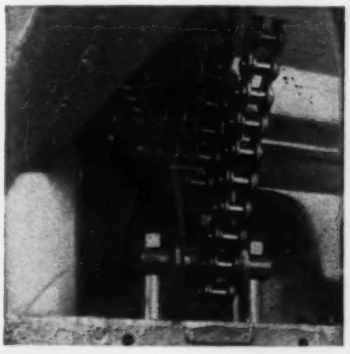
BAY CITY SHOVELS, Inc., BAY CITY, MICHIGAN

Export Office: H. M. Hein, 330 W. 42nd St., New York, U.S.A. (Oparo)

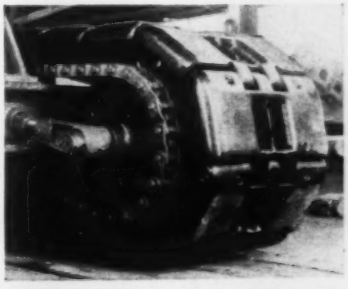
Illustrating 20 ton Crane of John S. Geiger's Sons excavating Ways at Newark, N. J.—a job of fine grading handled with a Clamshell.



The effectiveness of this instantaneous Electric Dipper Trip adds from 10 to 25% to daily yardage—and there's no extra charge.



Not only independent and positive but a *one-piece* continuous chain crowd from front drum to shipper shaft—a money saving feature.



This unique out-board bearing on crawler drive is but one of many ways in which maintenance cost is reduced in standard construction.

Power operated, booster clutches give easier operation without operation fatigue. Actuated by short lever throw without effort.

Straddle dipper sticks with welded crowd racking and sturdy electric welded box type boom.

One-piece unit-cast alloy steel carbody and revolving table absorbs shock and vibration—no deadweight.

All Bay City full revolving shovels are fully convertible without machinery changes—no extra gadgets, drums, chains, etc., to buy—Just change front end attachment.

BAY CITY SHOVELS

(Continued from page 88)

LUMBER, TIMBER, PLYWOOD—PER M FT. B.M., CARLOAD LOTS F.O.B.

	SHORT LEAF YELLOW PINE AND DOUGLAS FIR—All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. (Prices in Bold Face) All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft. (Prices in italics)									LONG LEAF Y. P. Merchantable grade up to 20 ft.		PLYWOOD* Rail freight increment (See note for base price)	
	1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10, S4S	3x12, R2h	6x12, R2h	12x12, R2h	2x12, R2h	12x12, R2h	5/8"	3/4"
Atlanta	**$21.00**	**$21.00**	**$20.00**	**$21.00**	**$21.50**	**$23.00**	**$28.00**	.....	.....	**$38.50**	**$52.00**	**$17.75**	**$21.60**
Baltimore	**28.00**	**29.50**	**34.50**	**33.50**	**34.00**	**35.00**	**42.50**	.....	.....	65.00	67.00	17.35g	21.15g
	30.00	*30.00*	*32.00*	*31.00*	*32.00*	*33.00*	*42.50*	*$42.50*	*$38.00*	.....	.....	.....	.....
Birmingham	**22.50**	**23.50**	**22.00**	**21.00**	**22.00**	**23.00**	**37.00**	**36.00**	**36.00**	.....	.....	16.25	19.85
[1]	25.50	25.50	29.00	27.00	29.00	40.00	60.00	.....	.....	52.00	60.00	.....	.....
Boston	**32.00[2]**	**32.00[2]**	**34.00[3]**	**34.00**	**53.00[1]**	**63.00[1]**	**77.00[1]**	.....	.....	77.00	77.00	17.35g	21.15g
	29.00	*29.00*	*34.00*	*34.00*	*36.00*	*36.00*	*45.00*	*45.00*	*50.00*	.....	.....	.....	.....
Chicago	**30.00**	**30.00**	**30.00**	**31.00**	**32.00**	**31.00**	**45.00**	.....	.....	75.00	80.00	13.15	16.05
	35.00	*35.00*	*35.00*	*35.00*	*36.00*	*35.00*	*40.00*	*40.00*	*40.00*	.....	.....	.....	.....
Cincinnati	**31.50**	**33.00**	**30.50**	**31.00**	**32.00**	**35.00**	**44.50**	.....	.....	53.00	56.00	16.25	19.85
	.....	.....	.....	.....	.....	.....	*46.00*	*46.00*	*46.00*	.....	.....	.....	.....
Cleveland	**32.00**	**32.50**	**32.00**	**32.50**	**34.00**	**36.00**	**43.00**	46.00	46.00	80.00	80.00	16.65	20.25
Dallas[e]	**28.50**	**32.00**	**31.50**	**28.50**	**30.00**	**32.50**	**53.50**	**52.50**	**52.50**	63.50	71.00	13.90	16.95
Denver[‡]	39.00[4]	38.00[4]	39.00[4]	42.00[4]	47.00[4]	41.00[4]	48.00[4]	60.00[4]	71.50[4]	.....	.....	9.90	12.05
Detroit	**28.00**	**28.00**	**29.00**	**28.00**	**31.00**	**34.00**	**37.00**	.....	.....	35.00	48.00	16.25	19.85
	.....	.....	.....	.....	.....	*37.00*	*38.00*	*43.00*	*43.00*	.....	.....	.....	.....
Kansas City	**28.00**	**30.00**	**29.00**	**27.00**	**29.00**	**31.00**	**35.00**	.....	.....	55.00	58.00	12.25	14.95
	29.00	*30.00*	*29.00*	*28.00*	*29.00*	*30.00*	*35.00*	*37.00*	*37.00*	.....	.....	.....	.....
Los Angeles [a]	*35.00*	*35.00*	*35.00*	*35.00*	*36.00*	*36.00*	*42.00*	*46.00*	*42.00*	.....	.....	9.35gh	11.35gh
Minneapolis [‡b]	46.00[6]	46.00[6]	.....	.....	.....	.....	.....	.....	.....	.....	.....	12.05	14.70
[‡]	*37.00*	*37.00*	*38.00*	*38.00*	*38.00*	*38.00*	*58.00*	*58.00*	*58.00*	.....	.....	.....	.....
Montreal [7]	*44.00*	*44.00*	*49.00*	*47.00*	48.00	58.00	84.00	.....	.....	135.00	145.00	.....	.....
	40.00	*40.00*	*40.00*	*40.00*	*40.00*	*41.50*	*41.00*	*40.00*	*39.00*	.....	.....	.....	.....
New Orleans	**22.00**	**22.00**	**20.00**	**19.00**	**20.00**	**22.00**	**42.00**	.....	.....	58.00	65.00	13.90	16.95
	26.00	*26.00*	*28.00*	*29.00*	*32.00*	*30.00*	*32.00*	.....	.....	.....	.....	.....	.....
New York [‡]	**38.00**	**39.00**	**37.00**	**38.00**	**38.00**	**39.00**	**42.00**	.....	.....	80.00f	82.50f	17.35g	21.15g
[‡]	.....	.....	*45.00*	*45.00*	*45.00*	*45.00*	*45.00*	*47.50*	*47.50*	.....	.....	.....	.....
Philadelphia	**23.50**	**24.00**	**25.00**	**25.00**	**26.00**	**26.50**	**28.50**	.....	.....	54.00	56.50	17.35g	21.15g
	34.00	*35.50*	*38.00*	*37.25*	*38.50*	*38.50*	*41.75*	*31.50*	*31.50*	.....	.....	.....	.....
Pittsburgh	**38.10**	**39.90**	**47.05**	**42.00**	**45.65**	**46.90**	**59.70**	.....	.....	.....	.....	17.00	20.70
	51.90	*49.60*	*49.60*	*49.00*	*48.90*	*49.25*	*66.55*	*66.55*	*66.55*	.....	.....	.....	.....
St. Louis [‡c]	**34.00**	**35.00**	**32.00**	**31.00**	**32.00**	**33.00**	**48.00**	*52.00*	*52.00*	73.00	72.00	13.90	16.95
San Francisco [d]	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*19.00*	*23.00*	*23.00*	*23.00*	.....	.....	7.30g	8.90g
Seattle	*22.00*	*22.00*	*22.00*	*22.00*	*22.00*	*22.00*	*27.00*	*27.00*	*27.00*	.....	.....	0.00	0.00

Bold Face type, Southern Pine. *Italics, Douglas Fir.* [1] Long leaf. [2] Roofers' N. C. Pine. [3] Spruce. [4] Native. [5] Western Pine, No. 3 Common. [7] Pine. [8] Norway Pine. ‡ Delivered. *a* Yard prices. *b* Contractors discount in Minneapolis and St. Paul discontinued May 21, 1938. *c* 5M ft. or less. *d* At ship's tackle. *e* 10% discount taken off. *f* Up to 18 ft.

NOTE: Special concrete form grade Fir Plywood, 4' by 8' panels, 5-ply, sanded 2 sides, water resistant glue, carload lots, delivered per 1,000 sq. ft. surface. Seattle base price on 5/8", $74.00; on 3/4", $81.50; price includes oiling and sealing charges. For other centers add rail freight increment from table for proper size. For resin dipped treatment, add $10.00 per M. *g* Lower rate by water shipment. *h* 50,000 lb. minimum.

* Plywood prices to hold for balance of year, but many manufacturers are out of market. Will not take future orders.

GLASS, EXPLOSIVES, CHEMICALS

	WINDOW GLASS—Discounts from jobbers list, Sept. 15, 1928 Single or Double Thickness A quality	WINDOW GLASS—B quality	EXPLOSIVES—Per lb. 40% Ammonia Gelatin in 50-lb. cases delivered in 200 lb. lots*	
Atlanta	75%*d*	75%*d*	$0.15	
Baltimore	83%*d*	82%*d*	.15	
Birmingham	89%	90%	.105	
Boston	82%*d*	82%*d*	.15	
Chicago	79%*d*	79%*d*	.15	
Cincinnati	79–10%*d*	79–10%*d*	.15	
Cleveland	79–10%	79–10%	.19	
Dallas	80%*d*	80%*d*	.165	
Denver	76–10%*d*	76–10%*d*	.15*e*	
Detroit	79–10%*d*	79–10%*d*	.15	
Kansas City	79–10%*d*	79–10%*d*	.155	
Los Angeles	88%	90%	.1575	
Minneapolis	76%*a*	76%*a*	.155	
Montreal	70–10%*b*		.17†	
New Orleans	80%*d*	80%*d*	.16	
New York	82%*d*	83%*d*	.20*f*	
Philadelphia	89–10%	90–10%	.15	
Pittsburgh	79%*a*	79%*a*	.1425	
St. Louis	79–10%*d*	79–10%*d*	.155	
San Francisco	78%*d*	83%*d*	.155	
Seattle	85%	88%	.1575	

Price of 60% Ammonia Gelatin is $0.015 per lb. higher than 40%

a Disc. from list Sept. 15, 1938 *b* Also less 6% tax exemption. *d* Discount from jobbers' list Aug. 15, 1938.

* Urban prices influenced by service charges or local storage and delivery regulations, do not consistently reflect quantity prices in less congested areas. *e* F.o.b. Louviers, Colo. *f* In boroughs of Kings, Queens and Richmond, and in Manhattan south of Canal Street, add delivery charge of $6.00 per trip. † F.o.b.

40% Ammonia Gelatin price ranges in other than urban areas, per lb. (except Seismograph Grades)

	C/L 20,000 lb. net	Tons	200 lb. lots
E. of the Miss., except Fla.	$0.105	$0.14	$0.16
W. of Miss., to Rocky Mtn. States, and Fla	.11 –.12	.135 –.15	.155 –.17
Rocky Mtn. States	.11 –.1325	.13 –.145**	.15 –.165**
Pacific N. W. States	.1075–.115	.1375–.15	.1575–.17
Pacific S. W. States	.1050–.1175	.135 –.1475	.155 –.1625

** F.o.b. Louviers, Colo., or Butte, Mont.

PILES, TIES—F.O.B.

PILES

Prices per linear foot, pine, with bark on, f.o.b. New York; delivered from barge 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf—Barge	Short Leaf—Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.18	$0.195
12 in.— 2 ft. from butt	6 in.	50 to 59 ft.	.225	.24
12 in.— 2 ft. from butt	6 in.	60 to 69 ft.	.23	.255
14 in.— 2 ft. from butt	6 in.	50 to 69 ft.	.24	.265
14 in.— 2 ft. from butt	6 in.	70 to 79 ft.	.28	.275
14 in.— 2 ft. from butt	5 in.	80 to 85 ft.	.40	.415
14 in.— 2 ft. from butt	5 in.	85 to 89 ft.	.42	.482

RAILWAY TIES

Prices f.o.b., per tie for carload lots:		6" x 8" x 8' Untr.	6" x 8" x 8' Tr.	7" x 9" x 8'6" Untr.	7" x 9" x 8'6" Tr.
Boston	Oak	$1.20	....	$1.65	....
	Pine	1.50	$2.25*a*	2.25	$3.20*a*
New York	S. L. Sap Pine	1.05/1.15	1.80	1.45	2.35
	Mixed Oak	1.35	1.90	1.85	2.45
Birmingham	White Oak	.85	1.50*a*	1.35	1.70*a*
	Southern Pine	.55*b*	1.10*ab*	.70	1.30*a*
Chicago	Oak	....	1.65*a*	....	2.25*a*
	Southern Pine	....	1.53*a*	....	2.13*a*
Los Angeles	Douglas Fir	.64	1.38*a*	.90	1.80*a*
Philadelphia	Red Oak	1.10	....	....	2.40*a*
St. Louis	White Oak	1.00	....	1.47	....
	Red Oak	1.00	1.50*a*	1.47	2.00*a*
	Sap Pine or Cypress	.90	....	1.37	....
San Francisco	Douglas Fir	.80*bef*	....	....	1.85*caf*
Montreal	Birch or Maple	.65	1.05*a*	.75	1.35*a*

Tr.— Treated; Untr.— Untreated. *a* Creosoted. *b* 6" x 8" x 8'6". *c* Empty cell. *d* Zinc. *e* Green. *f* At ships tackle.

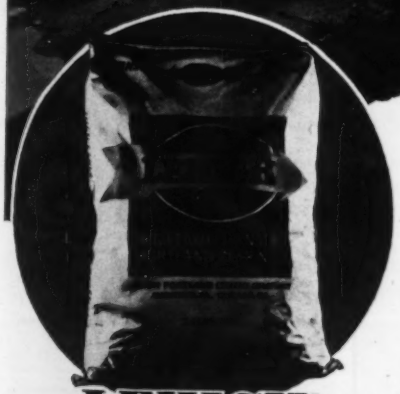
CHEMICALS

Water, sewage treatment, road work, f.o.b. carlots, New York

Bleaching powder, in drums, f.o.b. works, per 100-lb.	$2.00–2.85
Chlorine cylinders, liquid, per lb. delivered	.0525
Calcium chloride, 77–80%, flaked, in 400-lb. drums or 100-lb. moisture proof bags, delivered, per ton	22.00–25.00
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.40
Soda ash, 58%, in paper bags, per 100 lb. dense	1.10
Sulphate of aluminum, commercial, in 100-lb. bags, per ton	23.00
Sulphate of copper, in bbl., per 100-lb.	4.60

(Continued on page 92)

ARCHITECT:
Frederick C. Backus, Buffalo, N. Y.
CONTRACTOR:
Fleisher Engineering & Construction Co., Buffalo, N. Y.



LEHIGH
EARLY STRENGTH
CEMENT

WINTER OR SUMMER
This Contractor Saves Money

Contractors all over the country are having profitable experiences with Lehigh Early Strength Cement like those of Fleisher Engineering & Construction Company, who say:

". . . we were required to carry on work in cold weather—only 250 calendar days had been allowed for completion. We were confronted with the problem of providing temporary heat for winter protection of concrete—we decided that by using Lehigh Early Strength Cement we could strip slabs within 3 days from the date they were poured, thereby cutting down the period of protection and at the same time making these slabs available for the brick masonry operation."

Referring to subsequent work on the same job they say:

"On May 17 we poured a first floor slab, about 4800 sq. ft. The following day, May 18, 23 bricklayers were working on this same slab. We have convinced ourselves that money can be saved by using Lehigh Early Strength Cement in warm weather, too. It is possible to strip slabs much faster than with ordinary cement, thereby making it possible to get more uses out of form lumber, which results in a large saving, not only of lumber but of carpenter work in making up of beam sides, beam bottoms, and panels for slabs."

Results like these are possible because in 24 to 48 hours the strength of Lehigh Early Strength Cement is equal to that of normal cement at 7 days. This speed can be applied to any type of concrete work, winter or summer.

The Lehigh Service Department will gladly answer your questions.

LEHIGH PORTLAND CEMENT COMPANY

Allentown, Pa. Chicago, Ill. Spokane, Wash.

(Continued from page 90)

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE — PARTITION — SCORED Per M. lots of 2,000 pieces or over,			STRUCTURAL CLAY TILE — LOAD BEARING — SCORED Per M. lots of 2,000 pieces or over,			BRICK Per M. in quantity,		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	In paper Common hydrated	Carload lot Pulverized or lump
Atlanta	$90.00	$100.00	$185.00	$220.00	$230.00	$240.00	$12.50	$16.00	$24.00	$15.50	$15.50
Baltimore	74.00	80.00	165.00	190.00	240.00	290.00	13.00*k*	16.00*k*	18.00	14.00	2.45*m*
Birmingham	78.75	84.00	157.50	189.00	201.25	242.00	15.00	19.00	25.00	17.50	2.00*o*
Boston	82.10*a*	87.60*a*	164.20*a*	186.10*a*	243.20*a*	277.90*a*	17.00*i*	20.00*i*	19.00	12.50	3.10*j*
Chicago	68.10	72.60	135.90	185.70	234.90	268.10	11.00	12.00	16.40	14.40	12.20
Cincinnati	61.40	65.30	121.90	141.50	187.30	215.20	16.00	16.00	15.90	13.00	.....
Cleveland	54.50	58.00	109.00	130.50	175.50	200.50	16.00	16.00	16.00*j*	14.00*j*	2.75*jm*
Dallas	62.50	67.00	135.00	162.00	177.00	263.00	11.50*i*	13.50*i*	19.00	15.00	.95*n*
Denver	84.80	95.40	152.70	178.20	212.00	227.90	13.50	17.00	28.00*j*	17.00*j*	35.00*j*
Detroit	68.90	73.50	137.80	175.50	232.00	265.00*e*	15.70	17.00	13.50	11.75	12.75
Kansas City	64.50	66.50	86.00*c*	125.50	159.75	186.25	14.00	24.00	19.10	12.80	10.70
Los Angeles	73.50†*r*	89.50†*r*	128.00*c*†*r*	210.00†*r*	368.00†*r*	460.00†*r*	13.00	15.00	16.50	.....	17.50
Minneapolis	66.70	71.20	122.50	141.30	149.30	209.40	13.10	15.10*g*	21.00	16.00	19.00
Montreal	64.00*a*	77.00*a*	141.00*at*	77.00*a*	128.00*a*	.....	21.00	31.00	24.00	15.50	1.75*lo*
New Orleans	72.00	72.00	135.00	162.00	210.00	260.00	14.00	.....	18.30	12.08	14.10
New York	87.00	93.00	128.00	193.30*h*	238.80*h*	295.60*h*	13.50	.....	20.00	14.00	18.00
Philadelphia	77.40	82.50	154.50	185.70	229.90	284.60	11.00*s*	18.00*s*	15.50*q*	10.05	10.55
Pittsburgh	58.40	62.40	116.85	124.00	153.00	193.75	17.00	25.00	17.90	15.40	2.55*m*
St. Louis	62.00	88.00	120.00	180.00	234.00	280.00	16.00	17.00	22.00	16.00	2.30*lm*
San Francisco	84.00	94.50	225.00	.....	.....	.....	14.00	17.00	.55*o*	.40*o*	2.05*m*
Seattle	100.00	110.00	220.00	.....	.....	.....	17.50*f*	17.50*f*	20.00*s*	20.00*s*	20.00*s*

† F.o.b. *a* Smooth. *b* Carload lots delivered to job. *c* 6 x 12 x 12 in. *d* Not load bearing. *e* 48 lb. tile. *f* Less $1.00, ½ cash 15 days, balance 30 days. *g* Selected common. *h* F.o.b. Perth Amboy, N. J. *i* 50c per M. off for cash. *j* LCL. *k* $1.00 discount if paid in 10 days. *l* Lump. *m* Per bbl., 180 lb. *n* Per sack 100 lb. *o* Per bbl., 200 lb. *p* 280 lb. bag. *q* 15-ton cars. *r* 5% discount 10 days. *s* 2% off cash. *t* 5½ x 8 x 12.

PAINT, ROOFING—F.O.B. CARLOAD LOTS

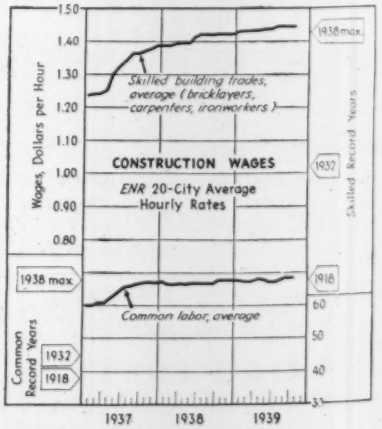
	RED LEAD Per 100 lb. in 600-lb. (Approx.) Dry *a*	WHITE LEAD bbl. Per 100 lb. in oil	READY-MIXED PAINT Per gal., drums Graphite *b*	Aluminum *c*	Ferric Oxide *d*	ROOFING SUPPLIES Carload lots f.o.b. factory Rolls, slate surfaced, 85–90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating per gal.	Tar pitch 350 lb. bbl. per ton
Atlanta	$9.25	$13.125	$1.30	$2.25	$1.20	$1.71	$1.65	$1.65	$0.36	$26.00
Baltimore	9.00	12.75	1.60	2.40	1.90	2.16	2.75	2.75	.40	27.50
Birmingham	9.25	13.125	2.35	2.35	1.85	1.84	1.73	1.73	.45	27.00
Boston	9.00	12.75	1.70‡	2.20‡	1.75‡	1.70‡	1.80*h*‡	1.80*h*‡	.45‡	20.00‡
Chicago	9.00	12.75	1.88	2.53	1.56	1.40*hf*	1.53*hf*	1.53*hf*	.26*f*	21.00*f*
Cincinnati	9.00	12.75	1.45	2.50	1.40	2.40	2.39*h*	2.39*h*	.36	21.00
Cleveland	9.00	12.75	1.90	2.60	1.40	1.55	1.55*h*	1.55*h*	.32	22.00
Dallas	9.00	13.50	1.80	1.95	....	2.75*h*	2.50*h*	2.50*h*	.60	....
Denver	9.50	13.25	1.65	2.40	.17*l*	2.45	4.00	3.00	.35	18.00
Detroit	9.00	12.75	2.00	3.00	1.75	2.40	2.75	2.75	.35	27.50
Kansas City	9.00	12.875	2.15*g*	2.40*g*	1.67*g*	1 93	2.09	2.09	.25	25.00
Los Angeles	9.25	13.25	1.60	2.25	2.30	2.10	1.50	....	.45	....
Minneapolis	9.00	12.875	....	....	...*c*	1.58*i*	1.45*hi*	1.45*hi*	.29	21.00
Montreal	9.25	9.00	2.25	2.80	2.35	3.05	1.85	2.15	.95	10.80*k*
New York	9.00	12.75	1.80	2.45	1.48	1.58	1.45*h*	1.45*h*	.23	24.00
Philadelphia	9.00	12.75	....	....	....	1.92*e*	1.99*he*	1.99*he*	.41*e*	21.00
Pittsburgh	9.00	12.75	1.05	1.95	.80	1.95	1.94*h*	1.94*h*	.34	26.00
St. Louis	9.00	12.75	1.70/1.90	2.50/2.75	1.50/1.90	1.50	1.50	1.50	.22	21.00
San Francisco	9.25	13.00	1.80	2.75	1.10/2.00	1.66	1.90	1.90	.325	20.50
Seattle	9.25	13.25	1.80	3.00	2.20	2.35	1.46/2.14	1.95	.63	24.75*j*

‡ Delivered. Note: Red lead in oil 50c. higher than white lead in oil. *a* Red lead prices change frequently due to pig lead price changes. *b* U. S. War Dept. Spec. 3-49A. *c* ASTM Spec. D266-31. *d* 80% minimum ferric oxide. *e* Subject to 25% discount. *f* Distributors' price to contractors. *g* 5 gal. can *h* Per roll, 65 lb. *i* Minneapolis and vicinity. *j* Asphalt pitch. *k* 550 lb. barrel. *l* per lb.

SKILLED AND COMMON WAGE RATES—PER HOUR

	Bricklayers	Carpenters	Struct. Iron Workers	Hoisting Engineers	Plasterers	Common Labor Building	Common Labor Heavy Const.
Atlanta	$1.25	$1.00	$1.375	$1.00/1.25	$1.25	$0.40/.50	$0.40/.50
Baltimore	1.50	1.25	1.65	1.50	1.25	.5625	.5625
Birmingham	1.50	1.125	1.25	1.125	1.00	.30/.40*a*	.30/.40*a*
Boston	1.50	1.375	1.50	1.375/1.625	1.625	.60/.85	.60/.85
Chicago	1.70	1.625	1.70	1.70	1.70	1.025	1.025
Cincinnati	1.625	1.45	1.525	1.00/1.525	1.625	.60/.75	.60/.75
Cleveland	1.625	1.375	1.50	1.50/1.75	1.50	.90	.90
Dallas	1.50	1.00	1.25	1.00	1.50	.40/.50	.40/.50
Denver	1.65*b*	1.50*b*	1.43*b*	....	1.50*b*	.718*b*	.718*b*
Detroit	1.50	1.25	1.50	1.50	1.55	.60/.75	.60/.75
Kansas City	1.625	1.375	1.50	1.50	1.575	.85	.50
Los Angeles	1.25	1.10	1.375	1.375	1.50	.625	.625
Minneapolis	1.375	1.25*d*	1.50	1.40	1.50*e*	.85	.85
New Orleans	1.00	1.00	1.25	1.00	1.00	.40	.40
New York	1.90*b*	1.75*b*	1.925	2.00*b*	2.00*c*	1.031	.875/.95
Philadelphia	1.65	1.25	1.50	1.50	1.565	.60	.60
Pittsburgh	1.75	1.50	1.50	1.25	1.75	.80	.70
St. Louis	1.50	1.25	1.75	1.57/2.00	1.58	.45/.875	.45/.875
San Francisco	1.75*c*	1.25*f*	1.50	1.50	1.60*c*	.81	.65
Seattle	1.60*c*	1.25	1.50*c*	1.50*c*	1.60*c*	.90*c*	.90*c*
Montreal	.80	.70	.75	.65	.80	.45	.40

a PWA. *b* 7 hr. day. *c* 6 hr. day. *d* 35 hr. wk. *e* 30 hr. wk. *f* Working under "stop-gap" agreement.



ENR Skilled Average: (Bricklayers, Carpenters, Ironworkers) $1.444

ENR Common Average: $0.685

Flotation for SPEED over Rough and Soft Haul Roads

Extra large pneumatic tires provide maximum flotation for the Koehring Trail-Dump. Heap loads do not "bog down" the Trail-Dump. High speed travel is maintained because the extra large tires "float" the load over rough roads, shifting sand, soft mud . . . Hauling costs are reduced when the Koehring Trail-Dump is on the job, because traction delays are lessened, high speed is maintained, big loads are hauled. Trail-Dump pneumatic tire flotation is greater than most other hauling units.

KOEHRING HEAVY DUTY

KOEHRING COMPANY, Milwaukee, Wis.

Free swinging, vertical hanging doors have ample clearance, when open, for ability to "get off the load" when dumping. Large tires, sturdy body and high speed Koehring Tractor are additional yardage cost saving features.

HEAVY-DUTY CONSTRUCTION EQUIPMENT

WHEN WHEELS STOP TURNING

EXPENSES PILE UP FAST!

Alemite Power Guns Help Prevent Costly Breakdown Delays

WHEELS on trucks, busses, tractors have to keep turning to make money for their owners. The minute those wheels stop, for any reason, profits stop and expenses pile up fast! That's why so many fleet owners and contractors depend on Alemite Power Guns for lubrication—to keep wheels turning dependably, with minimum maintenance cost!

That man up there is greasing a steering knuckle on a bus that weighs 15,200 pounds. Every 500 miles that knuckle gets a "shot" from an Alemite Model 6528 "Rock Crusher" Power Gun. This Gun—built by Alemite for just such heavy duty requirements—has the ruggedness and the power to get into tough, tight bearings—lubricating and maintaining them against expensive repairs.

Alemite Power Guns guard profits by helping prevent expenses. They can save a lot of money by helping you keep your wheels turning. Write today for our latest catalog!

Alemite Power Gun
Model 6528
Holds 40 lbs. of lubricant; develops 33 times available air pressure; operates on 100 to 200 lbs. of air. Easily portable. Patented construction eliminates "air pockets."

Alemite Barrel Pump
Model 6700
Pumps from original drum; operates on 75 to 175 lbs. of air; develops up to 6000 lbs. pressure, depending on piston ratio. May be used with single or multiple outlets.

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WORLD'S LARGEST MANUFACTURER OF LUBRICATION PRODUCTS

ALEMITE—*A Division of Stewart-Warner Corp.*
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City.....*State*.....
Firm Name.....

(*News Continued from p.* 43)

MEN AND JOBS

F. M. MacPherson, minister of public works of British Columbia, has been appointed a member of the board of transport commissioners of Canada.

Kenneth D. Pratt, Charleston, W. Va., is in charge of the mine sealing program for West Virginia sponsored jointly by the state of West Virginia, the United States Public Health Service and WPA. The mine sealing program has been drafted in an effort to control stream pollution in southeastern Ohio, abandoned mines to be closed so as to prevent drainage of contaminated water into streams and rivers.

Glenn L. Bobbitt has been named director of operations for the WPA in North Carolina. A former general contractor, Bobbitt has been serving as acting director since April 1, when the post became vacant with the advancement of C. C. McGinnis to state WPA administrator. Bobbitt first became connected with the federal relief program as an ERA project supervisor and from 1935 to 1937 he served as division engineer with the WPA at Elizabeth City, N. C. and Williamstown, N. C., until he was appointed coordinating engineer in the state WPA office at Raleigh.

Leonard J. Bliss has been named assistant engineer with the municipal public works department at Greensboro, N. C. and R. E. Settan, North Carolina State Highway Department, has been appointed assistant to Ray Warren, city building inspector and superintendent of street maintenance.

Nicholas H. Dosker, chairman of the Louisville, Ky. Municipal Housing Commission, is now local housing administrator at Louisville.

Wilson T. Ballard, a former WPA engineer of the District of Maryland and at one time employed by the board of county commissioners in Baltimore County, Md., has been named chief engineer of the Maryland State Roads Commission. Nathan L. Smith is being replaced.

John Young, WPA engineer for Woodruff County, Ark., has been transferred to the same position in Jackson County, Ark. Harold Black of Pocahontas, Ark., succeeds Young at the Woodruff County office at McCrory.

C. E. Adams, formerly Arizona state highway commissioner, has been appointed a member of the Arizona State Board of Technical Registration.

W. W. Scott, city engineer at Bryan, Tex., has been named city manager succeeding James W. Ashton, who resigned to become city manager of Dallas, Tex. Scott was formerly connected with the Dallas public works department and later was employed by the PWA at Fort Worth and the WPA at San Antonio.

David Boyd, civil engineer, has been appointed general manager of the aircraft division of the Canadian Car & Foundry Co. Ltd., one of the leading aircraft manufacturing concerns of the Dominion of Canada. For the past 20 months Boyd has been works manager of the Fort William aircraft plant of the company, and will now be stationed at Montreal. He is a graduate of McGill University and was with the Dominion Bridge Co. Ltd. until 1936, when he resigned to join Canadian Car.

M. W. Maxwell, engineer and former industrial commissioner of the Canadian National Railways in the United States, has been made commissioner of development and natural resources for the national system in Canada. He also at one time was assistant engineer for the department of railways and canals in Canada.

George A. Soper, consulting engineer in the field of public sanitation, has been appointed a consultant in the U. S. Housing Authority and assigned to the management division of the USHA. Soper has directed the construction of filtration plants in many cities and was engineer in charge of sanitary work in the rehabilitation of Galveston, Tex., after the disastrous storm which occurred in 1900.

George N. Schoonmaker, chief engineer of the water department of the city of Toledo, Ohio, has been named temporary city manager to fill the place vacated by the resignation of John N. Edy, who has taken up new duties in the U. S. Government Budget Division, Washington, D. C. Schoonmaker has been in municipal service of Toledo for 28 years, his work starting there following his graduation from the University of Toledo and special work in hydraulics at the University of Wisconsin. In 1920 he was named commissioner of the water department and became a member of the Water Supply Commission in 1925, taking an active part in the preliminary planning for the city's Lake Erie water supply project which is now being constructed.

Facts that MUST be faced!

. . . IF YOU WANT LOWEST COST PER YEAR IN PAVEMENT SERVICE

Has lowest maintenance and longest life

•

A modern, even, travel-surface for traffic

•

High salvage after unusually long service

•

Withstands both weather and traffic damage

•

Pre-manufactured surface; easily inspected

•

The hardest, densest and toughest material

•

Arrests deterioration of base courses

•

Easily repaired with simple hand tools

•

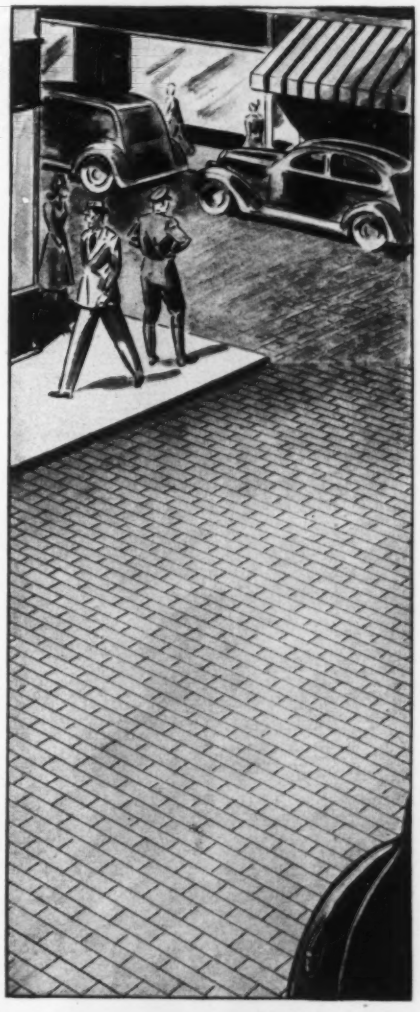
Amply visible; no glare by day or night

•

Permits Built-in markers for traffic lanes

•

Has the only factory-built safety surface



Whether you are paving a trunk-line highway or an obscure residential street, it is true economy to use brick.

It is much more resistant to weather damage to which all pavements are necessarily exposed. Brick is *too* tough, *too* indestructible to be destroyed by weather and traffic combined!

The greater your mileage of brick, the less interruption to traffic. And less pressure for repairs and reconstruction costs.

Brick has been made and used for more than 50 centuries. Yet in only the last decade many improvements have been made in its manufacture. And in the technique of using brick in pavements, more progress has been made than in all the years before!

You can build your community a brick pavement today that will far exceed even the unmatched performance of brick pavements of the past.

For further information, write to National Paving Brick Manufacturers Association, National Press Building, Washington, D. C.

BRICK

RESISTS DAMAGE FROM SALT AND CHEMICALS USED IN SNOW AND ICE REMOVAL

IT is no accident that Darling valves offer greater strength, greater efficiency and greater ease of operation. They cost a little more because they are built a lot better.

DARLING VALVE & MFG. COMPANY

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New York — Philadelphia
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DARLING

GATE VALVES

C. S. NICHOLS, Miami, Fla., city engineer, has been chosen chairman of a group of municipal and county engineers to coordinate supervision of work on the $1,155,000 airport at Miami, which is being built by Dade County and the cities of Miami, Miami Beach and Coral Gables, with aid by the WPA.

H. W. DENNIS, consulting civil engineer, has announced his retirement as chief civil engineer of the Southern California Edison Co. Ltd. and the opening of offices at Los Angeles.

FRANK AMES, resident engineer at Chattanooga, Tenn., is now resident engineer for the water resources branch of the United States Geological Survey for Oklahoma, replacing VERNE ALEXANDER who has gone to Kansas City to start an expansion program of the river and flood division in the Missouri River drainage basin. Ames is a graduate of the New Hampshire University and has been stationed in Austin, Tex. and High Point, N. C. before going to Chattanooga. Alexander, who will supervise the installation of 250 automatic rain gages to make rainfall intensity studies for various watersheds, in the vicinity of Kansas City.

MODESTO C. ROLLAND, subsecretary of communications and public works with the Mexican government, is now subsecretary of the national economy department, replacing Manuel Santillan, who has taken over Rolland's old duties.

RICARDO L. VAZQUEZ, late director of of Mexican National Highways Commission, is now in Rio de Janeiro, Brazil, supervising a $50,000,000 highway construction program for the Brazil government.

HARLAN HARRIS, rivers and harbors division, U. S. Army Engineers, Washington, D. C., has been transferred to the district office at Tulsa, Okla. Harris graduated from the civil engineering department of Iowa State College in 1931, joining the Iowa State Highway Commission at that time to work as an inspector for three years. The next two years were spent with the Rock Island district office, U. S. Engineers, one year as a surveyman on Dam No. 11 being built at Dubuque, Iowa as part of the 9 ft. channel program for the Upper Mississippi River and one year as junior engineer in the design office at Rock Island. Harris joined the Washington office in September, 1936.

GEORGE COBB's appointment as chief engineer of Baltimore, Md. has been confirmed by the Baltimore city council.

WHEN THERE'S ROCK IN YOUR WAY CALL FOR TIMKEN ROCK BITS

The faster you can put the powder holes down, the sooner you can blow the rock out of the way.

Contractors who use TIMKEN Bits know they are the fastest and most economical rock drilling tools ever developed—and they'll tell you so.

Fastest, because made of TIMKEN Electric Furnace Steel heat treated and hardened by the same advanced methods used in the production of TIMKEN Bearings.

Most economical, because longer lasting (more footage per bit) due to the greater abrasion and shock resistance of TIMKEN Steel.

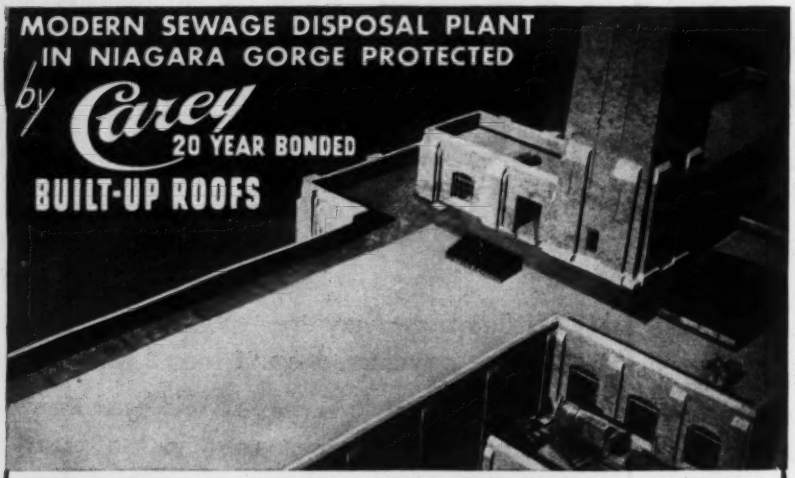
Save time and cut your rock drilling costs by putting TIMKEN Rock Bits to work now. "Miles of Smiles" for everyone. Write for name and address of nearest Authorized Distributor.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN
ROCK BITS

Manufacturers of TIMKEN Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; TIMKEN Alloy Steels and Carbon and Alloy Seamless Tubing; and TIMKEN Rock Bits.

MODERN SEWAGE DISPOSAL PLANT
IN NIAGARA GORGE PROTECTED
by Carey 20 YEAR BONDED
BUILT-UP ROOFS



The new sewage disposal plant of Niagara Falls, N. Y., is one of the outstanding achievements in this field. Located in Niagara Gorge, between the Whirlpool and the Falls, it is subjected to a ceaseless bombardment of spray and mist. To make sure of a roof that would withstand these severe conditions, a Carey Bonded Built-Up Roof was applied.

Carey Roofs last years longer — cost less per year — because each roof is engineered to the specific conditions involved. Whatever your roof problem, Carey can solve it to your complete satisfaction. No job too big or too small. Write today for details — address Dept. 30

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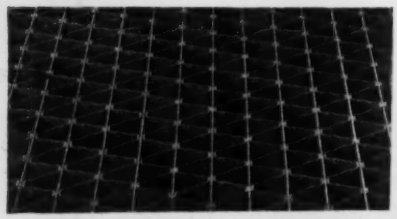
Waterproofing Materials . . . Expansion Joints . . . Asbestos Paper and Millboard
THE PHILIP CAREY COMPANY · Lockland, Cincinnati, Ohio
Dependable Products Since 1873
BRANCHES IN PRINCIPAL CITIES

IRVING DECKING
(The Open Steel Bridge Pavement)



Makes the Bridge Roadway Below
NON-SKID AND ECONOMICAL

May we send our catalog EF-200?

IRVING IRON WORKS COMPANY
LONG ISLAND CITY, N. Y.

A BRIDGE
IN PENNSYLVANIA

This photo is of a steel "GUNITED" viaduct over the Lehigh River, and the tracks of the L. V. R. R. and the New Jersey Central tracks, at Coplay (near Allentown), Pa. This job is illustrative of architectural effects possible by the use of "GUNITE".

Many examples of steel encasement by reinforced "GUNITE" are illustrated in our Bulletin 1200, and many other uses are shown. Send for a copy today.

The "CEMENT GUN" can be bought by anyone, and used without restrictions.

CEMENT GUN COMPANY
Manufacturers of the "CEMENT GUN"
ALLENTOWN, PENNSYLVANIA

WE ARE ALSO "GUNITE" CONTRACTORS
LET US BID ON YOUR WORK

Cobb, succeeds FRANK K. DUNCAN, who has retired, and GEORGE A. CARTER has been appointed to succeed Cobb. Other new appointments at Baltimore include: JOSEPH A. CLARKE as buildings engineer to succeed WILLIAM A. PARR and LUKE ELLIS as head of the bureau of mechanical-electrical service to succeed W. RAYNER STRAUS, who is expected to be named deputy chief engineer of the city. Reappointments are: LEON SMALL, water engineer and head of the bureau of water supply; FRED M. KIPP, JR., harbor engineer; GEORGE E. FINCK, sewerage engineer; EDWARD J. HECKER, head of the bureau of plans and surveys, and CONRAD ZIEGET, JR., head of the bureau of standards.

THOMAS M. BASTERASH, city engineer at Superior, Wis., was elected secretary of the engineering and public works section of the Wisconsin League of Municipalities at the league's state convention held recently at Wausau, Wis.

FREDERICK H. FOX, department of civil engineering at Tulane University, has been appointed to represent the South on a national committee of surveying and geodesy education sponsored by the Society for the Promotion of Engineering Education. Fox's appointment is for a three year period.

CHARLES E. STARR, Omaha, Neb., is a candidate for the Nebraska State Railway Commission. Starr, a civil engineer, worked in several foreign countries, before going to Nebraska 37 years ago.

GEORGE S. RICHARDSON has opened a consulting office in the Westinghouse Building, Pittsburgh, Pa., to engage in general practice on bridges, buildings and other types of structural work. Richardson was for many years engineer of bridge design for Allegheny County and has more recently been in consulting work in partnership with Walter Frick of Pittsburgh.

MEETINGS

CANADIAN INSTITUTE OF SEWAGE AND SANITATION, annual convention, Hamilton, Ont., October 19-20.

INSTITUTE OF TRAFFIC ENGINEERS, 10th Annual Convention, Atlantic City, N. J. Oct. 14–17.

MISSISSIPPI VALLEY ASSOCIATION, annual meeting, St. Louis, Mo., Oct. 15-17.

NATIONAL SAFETY COUNCIL, 28th National Safety Congress and Exposition, Atlantic City, N. J., Oct. 16–20.